

of the Tortoises were referred to *Testudo indica*, *T. triserrata*, *T. inepta*, and to two new forms proposed to be called *T. sauzieri* and *T. soumeirei*, the latter being possibly related to the gigantic Tortoises of Aldabra. Along with these Tortoises were found numerous bones of the extinct Lizard, *Didosaurus mauritanus*, of which an account was also given.

This paper will be published entire in the Society's 'Transactions.'

The following papers were read :—

- I. On some new Species of Earthworms from various parts of the World. By FRANK E. BEDDARD, M.A., F.R.S., F.Z.S., Prosector to the Society.

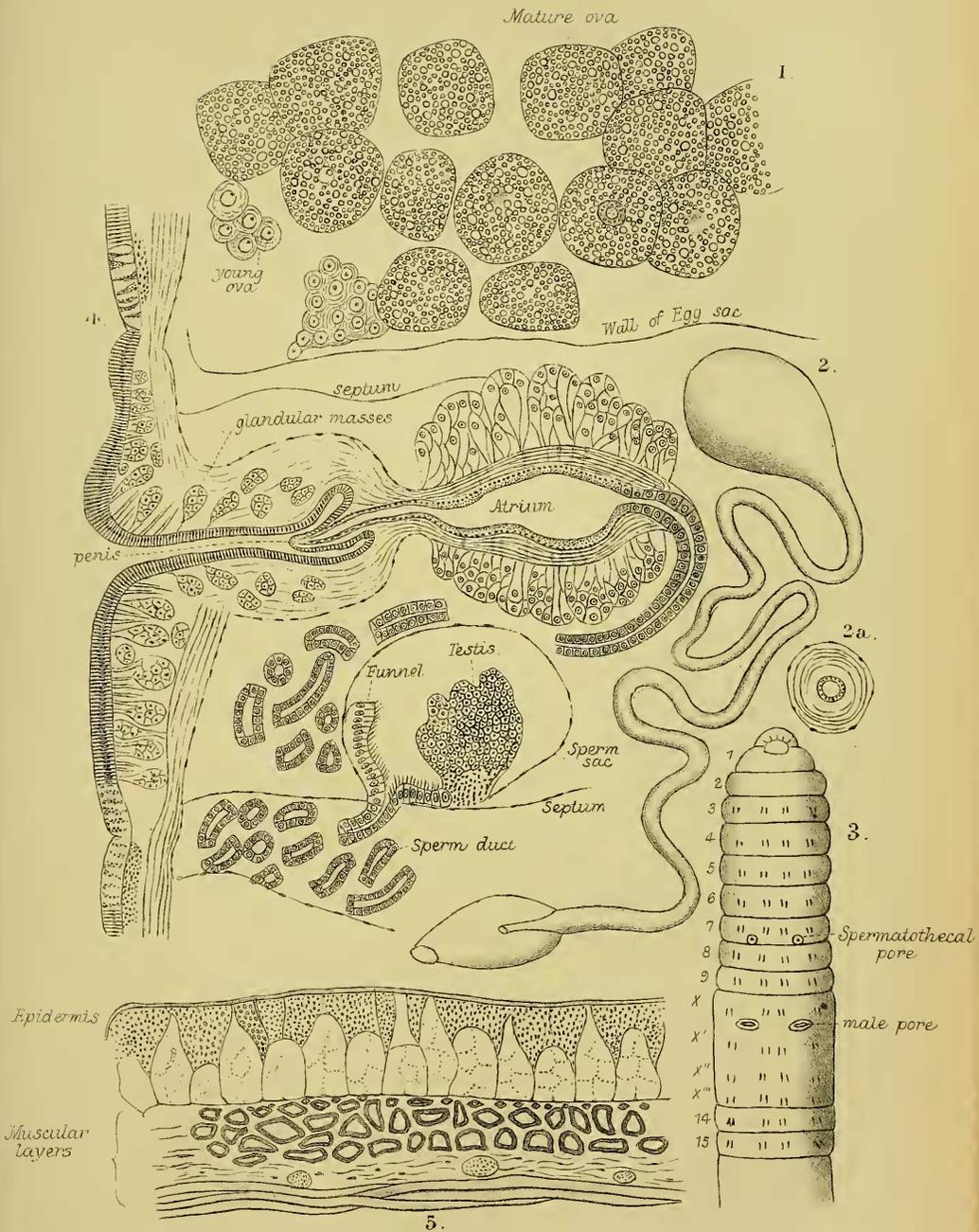
[Received December 2, 1892.]

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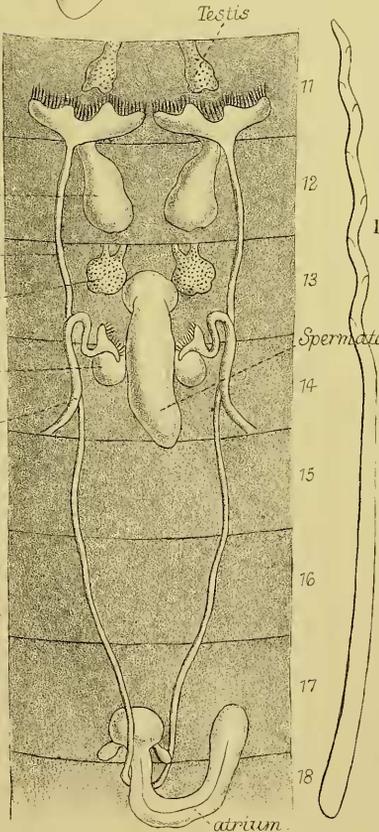
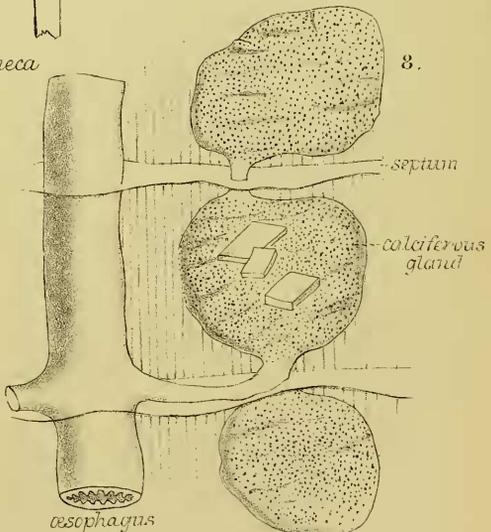
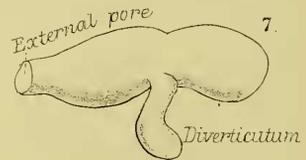
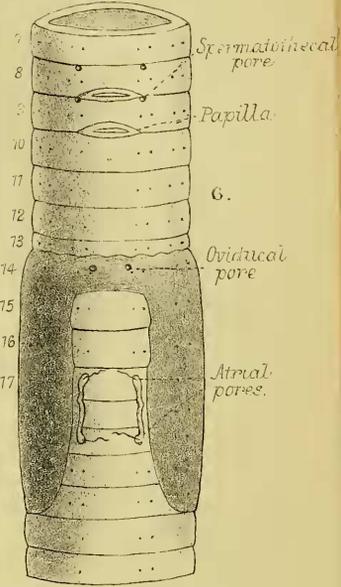
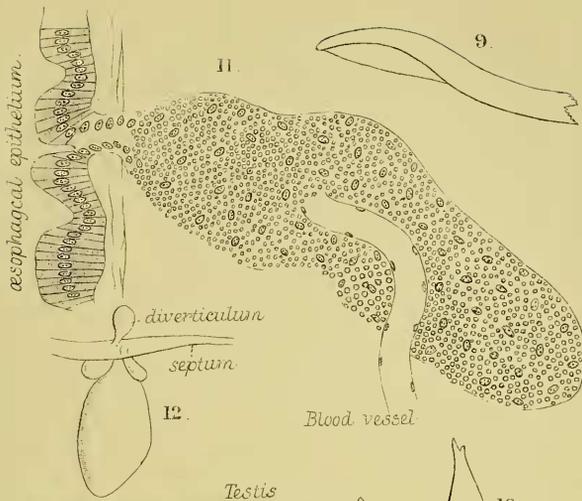
In the present paper I desire to offer to the Society some notes upon sixteen species of Earthworms, for the most part undescribed, which have come into my hands during the last year or two through the kindness of friends resident abroad, and from the Royal Gardens at Kew, through the kindness of Mr. Thiselton Dyer. The latter were received by me alive, and were carefully preserved for section-cutting; the specimens sent from abroad were, however, in most cases also well preserved.



F. E. B. del. P. Smit lith.

NEW SPECIES OF EARTH WORMS.
MONILIGASTER.

Mintern. Bros. imp.



F.E.B del. P. Smit lith.

Mintern Bros. imp.

NEW SPECIES OF EARTH WORMS.
 BENHAMIA, ACANTHODRILUS, MICRODRILUS, EUDRILOIDES.

I. Family ACANTHODRILIDÆ.

The majority of the new species of Acanthodrilidæ which I describe in the present paper are from New Zealand; I owe these specimens to the great kindness of Prof. T. J. Parker, F.R.S., and of Mr. W. W. Smith, of Ashburton.

The species of Acanthodrilidæ found in New Zealand have been hitherto referred to three genera; six years ago I described, under the name of *Neodrilus monocystis*¹, an Acanthodrilid differing from the typical forms (included within the genus *Acanthodrilus*) by the presence of but a single pair of atria and spermathecæ; this worm has been lately re-investigated by Dr. Benham², who has confirmed and extended my original account. I may add that I have within the last few months received some more examples of the same worm; there is accordingly no longer any doubt as to the characters of this species; it is not, as I at first thought it might be, a mere abnormality of such a species as *Acanthodrilus dissimilis*. Whether this Earthworm should be really referred to a distinct genus is another matter. I prefer, however, to leave the question alone for the present. In any case there can be no doubt whatever about the generic distinctness of *Deinodrilus* and the recently described *Plagiochæta*³. This latter may conceivably be identical with Hutton's *Megascolex sylvestris*⁴; at any rate that species is stated and figured by Hutton to possess numerous setæ arranged in couples, which is the principal external character of Benham's *Plagiochæta*.

The remaining Acanthodrilidæ have been all referred by me⁵ to the genus *Acanthodrilus*. This genus comprises altogether some 40 species, of which 8 are inhabitants of New Zealand. Forty species are not, perhaps, an unwieldy number for a single genus: it has nevertheless been divided into two genera, *Acanthodrilus* and *Benhamia*, by Michaelsen; *Benhamia*, it should be remarked, includes Benham's *Trigaster*. In distinguishing the two genera Michaelsen has not considered the characters of the New Zealand Acanthodrilidæ. *Benhamia* is the name applied to those Acanthodrilidæ with a "diffuse" nephridial system—that is, in which the nephridia are not paired, but open on to the exterior by numerous pores; added to this character, Michaelsen originally called attention to the fact that the species with a diffuse nephridial system possess a pair of gizzards, or, as in *Trigaster*, three gizzards; later he was led, by a consideration of the species *Acanthodrilus schlegelii*, to reconsider the definition of the genus and to use, as part of the generic diagnosis,

¹ "Observations on the Structural Characters of certain new or little-known Earthworms," Proc. Roy. Soc. Edinb. 1887, p. 157.

² "Notes on two Acanthodrilid Earthworms from New Zealand," Q. J. M. S. vol. xxxiii. p. 289.

³ Benham, *loc. cit.* p. 294.

⁴ "On the New Zealand Earthworms in the Otago Museum," Tr. New Zeal. Inst. vol. ix. p. 352, pl. xv. fig. E.

⁵ "On the Specific Characters &c. of New Zealand Earthworms," P. Z. S. 1885, p. 810. "On the Oligochætatus Fauna of New Zealand," P. Z. S. 1889, p. 377. "On the Structure of three new Species of Earthworms &c.," Q. J. M. S. vol. xxix. p. 102.

the phrase "as a rule more than one gizzard." According to this definition my *Acanthodrilus multiporus* should be referred to the genus *Benhamia*; and yet it differs from the African species (Africa is at present the headquarters of the genus) in a number of characters: there are no penial setæ; the calciferous glands are limited to a single pair; the dorsal vessel is double; the setæ are not strictly paired, but separated by a little distance. There are two other species described in the present paper which agree with *A. multiporus* in these points; a fourth species, *Acanthodrilus antarcticus*, agrees with *A. multiporus* in most of these characters, but not in all.

It has penial setæ; the two pairs of calciferous glands are in segments xv., xvi., and there is a smaller gland in xiv.; only the single gizzard and the distant setæ distinguish this species from the majority of those assigned by Michaelsen and others to the genus *Benhamia*. In spite, however, of the near resemblance of this particular *Acanthodrilid* to *Benhamia*, I am not inclined to refer it to that genus. In the first place it is possible that *Benhamia schlegelii*, which is stated to have but one gizzard, has really two; the two gizzards in this genus are often so close together that it is not a little difficult to make out that they are really two; the interval of soft-walled œsophagus between them is reduced to the lowest terms in many cases. In the second place, *Acanthodrilus antarcticus* is so like *A. multiporus* in other particulars that it would be doing violence to their obvious relationship to separate them¹. Taking into account also the distribution of these species it seems reasonable, now that the old genus *Acanthodrilus* is being broken up, to associate the New Zealand species here referred to into a genus distinct from *Benhamia*, which may be termed *Octochætus*. It will be thus defined:—

Octochætus, nov. gen.

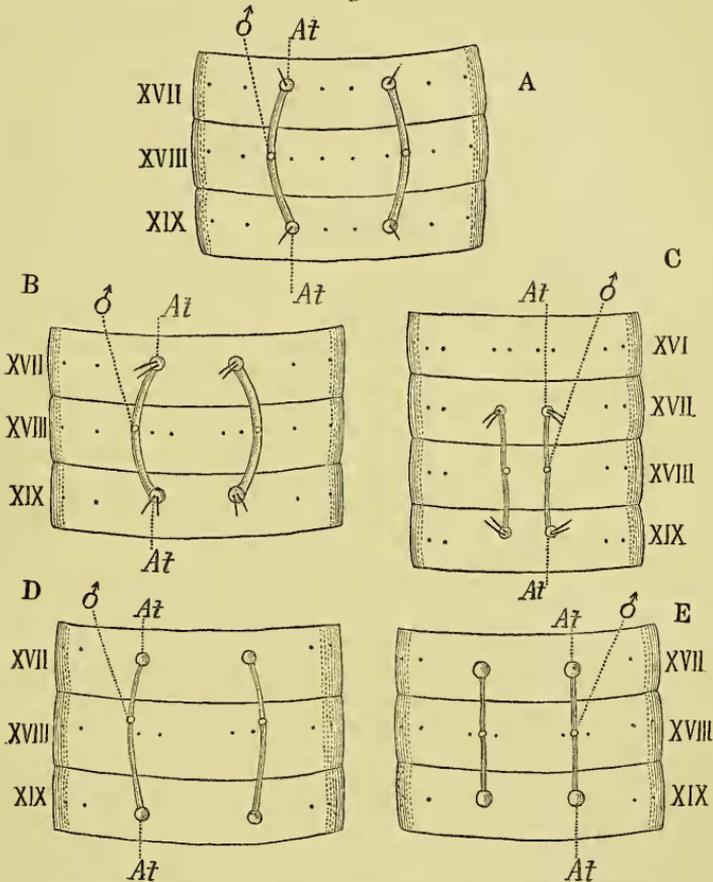
Prostomium not continued by grooves on to buccal segment; clitellum xiii.–xix. (xx.); male pores on prominent papillæ; setæ distant; ventral setæ present on segment xviii.; a single gizzard in vi., or v. and vi., or v.; calciferous glands one or two pairs, in xvii., xviii., or xv. and xvi.; typhlosole well developed; nephridia diffuse, a mucous gland present; dorsal vessel double from seventh segment onwards; diverticula of spermatheca very minute.—Distribution: New Zealand.

There is another character to which comparatively little attention has been paid, which may prove to distinguish the genera *Benhamia* and *Acanthodrilus*. In the two species of *Benhamia* described in the present paper, as well as in *B. stuhlmanni* (for an opportunity of examining which I am indebted to Dr. Michaelsen), there are no setæ upon the xviiith segment where the ventral pair should

¹ It may turn out that the position of the gizzard distinguishes my genus *Octochætus* from *Benhamia*; I am aware that Rosa speaks of the gizzards of *B. scioana* as occupying segments v. and vi.; this is at present the only exception to the rule that in *Benhamia* the gizzards are a segment or two further back.

be (woodcut, fig. 1); these setæ are also absent from the xviii and from the sixth segments, or rather they are there replaced by the penial setæ. In all the species of *Acanthodrilus*, on the other hand, which I have been able to examine, the ventral setæ are not missing from the xviii segment, though they are not present on the xviii

Fig. 1.



Segments bearing atrial and sperm-duct pores in a number of *Acanthodrilids*.

A. *Octochætus antarcticus*; B. *Acanthodrilus capensis*; C. *Benhamia* (any species); D. *Acanthodrilus smithi*; E. *Acanthodrilus novæ-zelandiæ*.

At. atrial pores; ♂, sperm-duct pores; the groove connecting the atrial pores and the setæ is indicated; penial setæ are omitted in D and E. The segments are numbered.

and sixth segments, being there replaced by the penial setæ; this is also the case with the genus *Octochætus*; in two of the species of that genus at any rate, viz. *O. multiporus* and *O. antarcticus* (woodcut, fig. 1), the ventral pair of setæ of segment xviii. are

present and quite normal; on segments xvii. and xix. the ventral-most seta is present and unmodified. *Octochætus antarcticus* is furthermore remarkable for the fact that the setæ of the xviiith and xixth segments appear at first sight to be present and normal; as a matter of fact, the outer seta of the ventral pair is replaced by the penial setæ, which occur exceptionally in this species: these setæ are very much smaller than in *Acanthodrilus dissimilis* for example, and can hardly be seen until they are examined microscopically, but they are undoubtedly there. The ventralmost seta of the ventral pair is not absent from these segments as it usually is, but is quite recognizable; this species is therefore in a less modified condition than is any other of the species of *Octochætus*, or *Acanthodrilus*, or *Benhamia*. In *A. annectens* and *A. paludosus*, described in the present paper, there is, as in *Octochætus*, a single seta ventrad of the atrial pores.

In all the species of *Benhamia* which I have dissected, the calciferous glands are different from those of *Acanthodrilus* or *Octochætus*. These glands are (in *Benhamia*) reniform pouches attached to the sides of the œsophagus; in *Acanthodrilus* and *Octochætus* these glands present the appearance of swellings upon the course of the œsophagus. Moreover, in *Benhamia* there appear to be always three pairs of calciferous glands which may, perhaps, prove to be always in segments xv., xvi., and xvii.; they have been for the most part described as in these segments, and it is possible that in those cases (e. g., *B. büttikoferi*, Horst) where they are stated to occupy the xivth, xvth, and xvith segments, a mistake of one segment may have been made; anyhow the three pairs seem to be characteristic, and nearly, if not quite, universal.

In the two species of *Benhamia* which I describe in the present communication, the spermathecae have a peculiar form, which is indicated in the accompanying drawing (Plate XLVI. fig. 7); the pouch is constricted in the middle, the constriction not coinciding with the attachment of the single diverticulum. Michaelsen has figured the spermatheca of *Benhamia stuhlmanni*¹, which shows precisely the same structure, but does not remark upon it in the text of his paper. This peculiar form of spermatheca is not, however, found in all the members of the genus *Benhamia*, for Horst figures the spermathecae of *Benhamia beddardi* as like those of the genus *Acanthodrilus*².

For the purpose of comparison I subjoin a definition of *Benhamia*:—

Benhamia, Michaelsen.

Prostomium sometimes continued by grooves on to buccal segment; *clitellum* xiii. (xiv.)—xiv. (xvii.); *setæ* strictly paired; two gizzards in vi., vii., or vii., viii.; calciferous glands three pairs in xiv.—xvi. or xv.—xvii.; *nephridia* diffuse; dorsal vessel single; penial setæ nearly

¹ "Beschreibung der von Herrn Dr. Fr. Stuhlmann im Mündungsgebiet des Sambesi gesammelten Terricolen," JB. Hamb. v. Anst. vii. Taf. i. fig. 8.

² "Descriptions of Earthworms.—IV. *Acanthodrilus beddardi*, n. sp., a remarkable Earthworm from Liberia," Notes Leyd. Mus. vol. x. pl. vi. fig. 1.

always present; no ventral setæ upon xviii.—Distribution: Tropical Africa, Tropical America, and India.

The species *Acanthodrilus novæ-zelandiæ*, *A. dissimilis*, *A. rosæ*, and *A. smithi* (to be described in the present paper) I refer to the genus *Acanthodrilus sensu stricto*. I am doubtful about *Acanthodrilus annectens*, a species which I described some years since¹. In possessing paired nephridia it agrees with *Acanthodrilus* (s. s.), but it has the "mucous gland" of *Octochætus*, and the gonads are placed in contact with the funnels of their ducts, as is the case with three of the species which I refer to this genus, *Octochætus*; it has the further peculiarity that the sperm-ducts run in the thickness of the body-wall, a peculiarity which it apparently shares with the genus *Octochætus*, but which, among other Oligochæta, is rare, and only found, so far as I am aware, in *Diplocardia communis* and in the not nearly allied form *Siphonogaster*. The absence of calciferous glands is occasionally met with in *Acanthodrilus*. The existence of this species serves to indicate how closely allied are the forms which do, and the forms which do not, possess a diffuse nephridial system. Another instance of the same approximation of species to each other which differ in their excretory system is afforded by *Benhamia beddardi* and *Acanthodrilus unguulatus*; in both of these there is an elaborate arrangement of modified setæ and glands appended in the neighbourhood of the spermathecæ. These facts possibly indicate that the passage from the diffuse to the paired nephridia may occur more than once in a genus, and of course discount the value of the modifications of the nephridial system in classification.

I shall now describe two apparently new species which I refer to my genus *Octochætus*:—

1. *Octochætus thomasi*, n. sp.²

I have received on various occasions during the last few years examples of a small-sized Acanthodrilid from New Zealand, which I have hitherto confounded with *O. multiporus*. I regarded these individuals merely as small specimens of that species. A full-sized specimen of *O. multiporus* is a very large worm, measuring, even in a contracted condition, some 14 inches in length by half an inch or so in breadth. On the other hand, the worms which I now consider to represent a new species of this genus are of a much more slender build. Unfortunately, I am not in a position to give any exact measurements; the specimens which I possess are none of them intact. An individual measuring 144 mm. is, I fancy, nearly complete; the diameter of this worm is not more than 5 mm., and the body consisted of 230 segments.

The external characters of the species recall *O. multiporus*; the *protonium* is not continued by grooves on to the buccal segment. That segment and the two following are not annulate; segments

¹ "On the Structure of three new Species of Earthworms &c.," Q. J. M. S. vol. xxix. p. 102.

² Named after Prof. A. P. Thomas, of Auckland, New Zealand.

iv., v., vi. are triannulate, the middle annulus being much the narrowest; segments vii., viii., ix. are very much wider (antero-posteriorly), but still triannulate; so, too, are the segments which immediately follow, though much narrower. After the clitellum the segments continue to be triannulate.

The clitellum extends from segments xiii.–xix.; it is at first complete, extending right round the body; but on segments xvi.–xix. there is a ventral median area without any glandular modification.

The atrial pores are upon very conspicuous papillæ; the two of each side of the body are connected by a longitudinal groove, which is not straight but has a semicircular outline, the convexity being dorsal. The oviducal pores are just in front of the ventralmost seta. The setæ are rather distant from each other; a somewhat greater distance separates the two lateral setæ.

I have not seen any dorsal pores.

The pharynx occupies the first four segments of the body; the gizzard is very elongated, with parallel margins; it measures 6.5 mm. in length; the gizzard occupies two complete segments, the fifth and the sixth. The œsophagus bears in segment xvii. the single pair of calciferous glands, which present the appearance of an oval swelling of the œsophagus itself. The intestine commences in the sixth segment.

The septa of some of the anterior segments are, as is so constantly the case with Earthworms, strengthened and bound together with thin muscular strips which occasionally pass through one septum to reach another lying behind it; the number and appearance of these septa is illustrated in the accompanying drawing (woodcut, fig. 2, p. 673). The first septum, which is thin and transparent, divides segments iv./v.; it is traversed by a large number of muscular threads which bind the pharynx to the parietes: the next septum is also thin and delicate in texture; it is attached at the end of the first third of the gizzard; a good number of the threads which bind the pharynx to the parietes pass through it. The following seven septa are thickened; the last of them therefore bounds the thirteenth segment anteriorly.

The dorsal vessel is completely double; the two tubes of which it is composed retain their individuality where they pass through the intersegmental septa. The dorsal vessel is, however, at first a single tube; it is not until the seventh segment that it becomes double. In this segment commences the supra-intestinal vessel, which is large and very conspicuous. In segments x., xi., xii., xiii. are the four pairs of dilated hearts; in a few segments, anterior to the tenth, are more delicate peri-œsophageal vessels.

There are, as in *Octochaetus multiporus*, a pair of large nephridia lying close against (in front of) the first septum; from each of these a slender duct was traced forwards which opens, it may be inferred, into the buccal cavity; I did not, however, succeed in seeing the actual orifice. In the rest of the body the nephridia are also constructed upon the plan which is characteristic of *Octochaetus multiporus*; the tufts appear to be massed chiefly round the setæ.

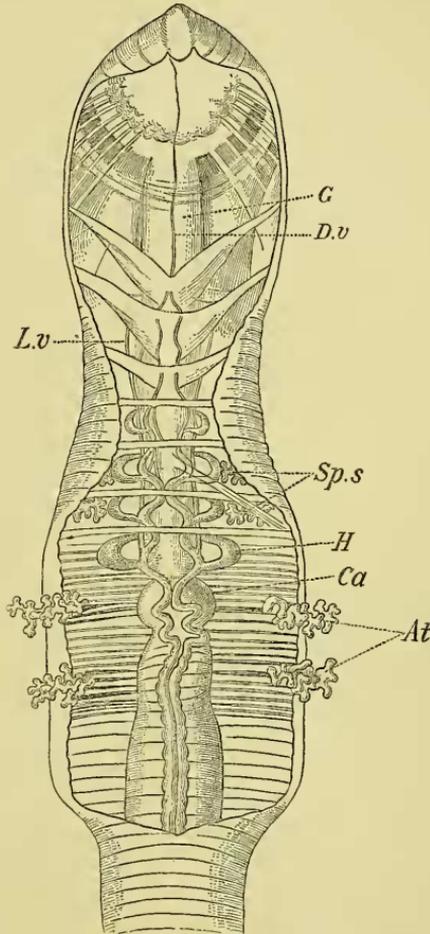
Both testes and ovaries occupy the usual segments, but the gonads

are attached to the posterior wall of their respective segments, as they are in *Acanthodrilus annectens* and in *Octochætus multiporus*.

The racemose sperm-sacs are in xi., xii.

The spermathecæ are elongated pouches in viii. and ix.; they

Fig. 2.



Octochætus thomasi, dissected to show the principal organs.

G, gizzard; *D.v.*, dorsal vessel; *L.v.*, lateral vessel; *H*, hearts;
Sp.s., sperm-sacs; *Ca*, calciferous gland; *At*, atria.

appear to have numerous minute diverticula crowded round the duct near to its external opening.

The atria do not extend beyond their proper segments. A number of strong muscular bands, such as occur in *Octochætus multiporus*, pass from the lateral to the ventral walls of segments, and serve, no

doubt, to extrude the papillæ already spoken of, on to which the atrial pores open. There are no penial setæ.

This species is clearly most intimately related to *Octochætus multiporus*; indeed it is not a little difficult to separate the two; the difficulty, too, is increased by the variability of the larger species. This difference of size is the most obvious difference; and it is, I think, a difference that must be allowed. The variability of *Octochætus multiporus* unfortunately concerns those very organs upon which I had at first attempted to lay stress as distinguishing the two. In some individuals of *Octochætus multiporus* the gizzard is limited to the sixth segment, the second septum lying just in front of it, attached therefore to the œsophagus; but in other specimens this septum is inserted on to the gizzard itself, which thus occupies two segments, as in *Octochætus thomasi*. In two individuals the single pair of calciferous glands are in segment xviii.; but in others, as is the case with *Octochætus thomasi*, in the xviiith. Another possible distinction between the small and the large species concerns the dorsal vessel; in *O. thomasi*, as already mentioned, this vessel is single until the seventh segment. In a specimen of *Octochætus multiporus* the dorsal vessel was single until the commencement of the sixth segment only; in this segment it became double; in another the single dorsal vessel became double at the septum separating v./vi., but immediately after the two halves became fused, to again divide at about the middle of the segment. The shape of the gizzard and its relative length in the two species does appear to differ; in the smaller species it is proportionately longer and narrower than in the large species.

The next new species cannot by any possibility be confounded with the foregoing; I name it after Capt. Hutton, who has done so much in describing the fauna of New Zealand.

2. *Octochætus huttoni*, n. sp.

I had a number of examples of this species sent to me by Mr. W. W. Smith; they were all of approximately the same size; an individual selected for accurate measurement was 130 mm. in length by 7 mm. in breadth at the clitellum. It consisted of 233 segments.

The colour during life was pink, the clitellum being white; this colour is due to the fact that the species, like *O. multiporus*, had no pigment in the skin.

The anterior segments are much annulated. After the clitellum there is also, though to a less extent, an annulation of the segments.

The clitellum occupies segments xiii.-xix. (xx.).

The atrial pores are borne upon a very prominent fold overhanging on each side the ventral surface, which in this region appears in consequence as if hollowed out. The two pores of each side are connected by a longitudinal furrow.

The prostomium is short and wide, and is not continued by grooves on to the buccal segment, which is marked by numerous furrows.

The setæ are in pairs not closely approximated.

The dorsal pores commence between xi./xii.

The gizzard measures 8 mm. in length, and appears at first sight to occupy about four or five segments; it really corresponds to segment v., which is increased in size at the expense of neighbouring segments for its reception. The calciferous glands are in xv. and xvi.; they have the appearance of being merely dilatations upon the course of the œsophagus, which is the case with the other species of this genus.

The intestine begins in xviii., but the typhlosole (which is very prominent) does not begin before segment xx.; it ends at about 60 segments before the end of the body.

The first septum is in front of the gizzard. After the gizzard are six stout septa, and, following these, are two which are rather more developed than the rest, but not as strong as those which precede them. The nephridia are diffuse, and there is a particularly dense mass of tubes in the anterior segments, which seem to represent the mucous gland of *Octochætus multiporus*¹.

The dorsal vessel is double, and there are three pairs of hearts in x.-xii.

All the gonads are attached to the front wall of their segments.

The spermatothecæ (in viii., ix.) have a minute clump of diverticula, presenting the appearance of a solid body, about the size of a pin's head.

There are no penial setæ.

Hab. New Zealand.

This species is evidently perfectly distinct from the last; it is, however, clearly referable to the same genus, if this genus be admitted. The diffuse nephridia, double dorsal vessel, separate setæ, absence of penial setæ, and anterior position of gizzard cause it to resemble the three other species which I refer to the genus *Octochætus*. It differs from *O. multiporus* and from *O. thomasi* in the following points:—

- (1) The prominence of the atrial pores as seen from the outside.
- (2) The position of the gizzard in segment v., and its limitation to this segment.
- (3) The presence of two pairs of calciferous glands in xv., xvi.; in this the present species resembles *O. antarcticus*.
- (4) The existence of only three pairs of hearts instead of four.
- (5) Six thickened septa instead of seven.
- (6) The attachment of the gonads to the front wall of their segments; in this character *O. huttoni* resembles *O. antarcticus*.

The next species which I describe is referable to the genus *Acanthodrilus* (s. s.).

3. *Acanthodrilus smithi*, n. sp.

I have been able to examine, through the kindness of Mr. W. W. Smith, some seven examples of this new species of *Acanthodrilus*; the general appearance of the worm is very different from that of

¹ I did not ascertain whether these opened into the buccal cavity as in *O. multiporus*.

the other New Zealand *Acanthodrilidæ* which I have so far had the opportunity of studying—so different that it was unnecessary to dissect the species in order to ascertain its distinctness. All the New Zealand *Acanthodrilidæ*, with the exception of the present species, are either devoid of pigment in the skin, or, if pigment is present, the worms are of a brownish colour. *Acanthodrilus smithi* is (after preservation in alcohol) of a violet colour, the clitellum being whitish yellow; the ventral surface of the body is the same colour as the clitellum.

The worms are slender, measuring up to 75 mm. in length with a diameter of 3 mm. at the widest part of the body. An individual of this size consisted of 114 segments.

The prostomium completely divides the buccal segment, as it does in the New Zealand species *Acanthodrilus novæ-zelandiæ* &c.

The setæ are paired and the pairs are equidistant, the body being thus divided into four equal areas. There is no difference in size between the setæ of different segments.

The clitellum occupies segments xiii.—xix.; it is saddle-shaped, and is not developed ventrally beyond the outermost of the two ventral setæ.

I could find no dorsal pores.

The nephridiopores are very evident; they alternate in position from segment to segment, as is the case also with other species of *Acanthodrilus* from New Zealand. They sometimes lie in front of the dorsal, sometimes in front of the ventral setæ. When they open in front of the ventral setæ they appear to be particularly related to the outer of the two setæ; when, on the other hand, they open in front of the dorsal setæ, the orifice is in front of the innermost of the two setæ which constitute the pair.

The spermathecal pores lie on the border-line between segments vii./viii. and viii./ix. They lie in front of and to the outside of the ventral pair of setæ.

The atrial pores (see fig. 1, p. 669) are upon segments xvii. and xix.; their position corresponds exactly with that of the ventral pair of setæ, which are absent from these segments. The ventral setæ are, on the other hand, present upon the xviiith segment; and the sperm-duct pores lie a little to the outside of and in front of these setæ; their position therefore corresponds more accurately to that of the spermathecal pores than do those of the atria.

The internal structure does not present any special points of interest, being on the whole very similar to that of the other New Zealand *Acanthodrili*.

The nephridia are alternate in position, as in *A. dissimilis*; this peculiarity is confined, as regards the genus *Acanthodrilus*, to the New Zealand species.

The dorsal blood-vessel is single; there are four pairs of dilated hearts, the last of which is in segment xiii.

The alimentary canal is furnished with a rudimentary gizzard, which needs a microscopical examination for its demonstration; such as it is, it lies in segment v. There are no conspicuous calciferous glands,

but in segments xiv. and xv. the œsophagus becomes wider, and its lining membrane much folded and very vascular. This region evidently corresponds to the calciferous glands of other Earthworms: all doubt upon the matter appears to be removed by the discovery of crystals exactly similar to those which occur in the calciferous glands of other Oligochæta. The vascularity of the œsophagus is not limited to these two segments; from the tenth segment onwards its walls are vascular, though not so folded as in the two segments xiv. and xv. The intestine commences in the xviiiith segment.

The gonads occupy the usual position; the sperm-sacs are in segments ix., x., xi., xii. The atria are like those of other Acanthodrilidæ, and each is provided with a bundle of penial setæ. These setæ (Plate XLVI. figs. 9 and 10) are recurved at the extreme end; the extremity has two delicate wing-like processes which, when the seta is viewed from above, give to the end an oval contour; the tip of the seta in this aspect is seen to be bifid. The absence of any ornamentation upon the setæ appears to distinguish the New Zealand Acanthodrilidæ with the exception of *Octochætus antarcticus*, where it is only very slight.

The spermathecae are, as is nearly universally the case with the Acanthodrilidæ (*Acanthodrilus* [*Diplocardia*] *communis* is, so far as I am aware, the only exception), two pairs situated in segments viii. and ix. Each pouch has three small diverticula, one of which is constantly in front of the septum.

4. *Acanthodrilus paludosus*, n. sp.

This is a small and slender worm, but I have not preserved any accurate notes of its dimensions; it was about an inch in length and something like 1 mm. in diameter. It was found in a marsh in New Zealand by Mr. W. W. Smith, to whom I am indebted for the specimen.

This species is a near ally of *Acanthodrilus annectens*, which I have already referred to as possibly worthy of generic separation from the Acanthodrilidæ with paired nephridia.

The present species has the same arrangement of the setæ, which are not modified upon any of the segments of the body. I did not describe, in my account of *Acanthodrilus annectens*¹, the fact that only one of the two ventral setæ is missing on the segments which bear the atrial pores, *i. e.* xvii. and xix.; the apertures take the place of the missing outer seta of the ventral couple; on the xviiiith segment both setæ of the ventral pair are present; the pore itself lies to the outside of the pair. *Acanthodrilus paludosus* shows exactly the same arrangement, and both species therefore differ from *Acanthodrilus smithi* and from the other New Zealand species of *Acanthodrilus* in this matter: in them the ventral setæ are entirely absent from the xviiiith and xixth segments.

The clitellum was not developed, though in other respects the worm appeared to be fully mature.

¹ "On the Structure of three new Species of Earthworms &c.," Q. J. M. S. vol. xxix. p. 102.

The gizzard lies in segments v. and vi., but only one-fourth of the organ lies in the anterior segment. Calciferous glands are, as in *A. annectens*, totally absent; the intestine begins in the twentieth segment. Some of the septa are thickened.

There is a mucous gland, and the nephridia are paired.

The gonads are normal in position; they are not situated on the posterior face of their segments as is the case with *A. annectens*. Opposite to them are the funnels of the ducts, which are like those of other species and occupy the same segments. The sperm-ducts, however, agree with those of *A. annectens* to differ from those of most other Earthworms, in running within the thickness of the body-wall; they retain their individuality until just before the external aperture.

The atria have no peculiarities of structure; there are no penial setæ; strong muscular bands run from the lateral to the ventral parietes in the neighbourhood of the atria, a character which unites this species and *Acanthodrilus annectens* to the genus *Octochætus*: the presence of these muscular strands is perhaps to make up for the absence of penial setæ; the atrial papillæ can possibly be considerably protruded by their means, and as they (the extruded papillæ) are tapered at the extremity, they can, it is likely, be actually inserted in the spermathecal orifice and convey the sperm direct.

The oviducal pores are placed just in front of the ventralmost setæ.

The oviducts have no egg-sacs attached to them.

The sperm-sacs are in segments ix., xi., xii.; I could not find any sac in the intervening segment.

The spermatothecæ are, as in all the *Acanthodrilidæ* (excepting only *A. communis*), two pairs and lie in the usual segments, *i. e.* viii., ix.; each pouch has, as in *Acanthodrilus annectens*, more than one diverticulum; in the present species there are two, one of which is rather the larger.

Closely allied to *Acanthodrilus annectens* as this species undoubtedly is, there will be no difficulty in distinguishing it. The chief points of difference are:—(1) position of gizzard; (2) normal position of gonads; (3) form of spermatothecæ.

5. *Acanthodrilus falclandicus*, n. sp.

Some time since I added¹ some anatomical details to Michaelsen's account of *Acanthodrilus georgianus*², which had been derived from the study of what I believed to be an identical form. More recently Michaelsen³ gave reasons for regarding the species described by myself as not identical with that named by him *Acanthodrilus georgianus*. Dr. Michaelsen has been so good as to send me two specimens of his *A. georgianus*, and I have therefore been able to follow the account which he has given regarding the species.

¹ "Contributions to the Anatomy of Earthworms, with descriptions of some new Species," Q. J. M. S. vol. xxx. p. 421.

² "Die Oligochaeten von Süd-Georgien &c.," JB. Hamb. wiss. Anst., Bd. v. p. 68.

³ "Oligochaeten des Hamburger naturhistorischen Museums, iii.," JB. Hamb. wiss. Anst. vii. p. 7.

The differences between the two forms may be stated in a tabular form as follows:—

Setæ.—In *A. georgianus* the distance separating the two setæ of the lateral couple is hardly greater than that which separates the ventral couple.

In my species, which I propose to call *A. falclandicus*, the distance between the lateral setæ is markedly greater than that between the ventral setæ.

Nephridiopores.—In *A. georgianus* these are placed in front of and below the third seta.

In *A. falclandicus* these pores are directly in front of the third seta of each segment.

Gizzard.—Totally absent in *A. georgianus*.

Rudimentary in *A. falclandicus*.

Penial setæ.—In *A. georgianus* these have fewer tubercles upon the extremity and these tubercles have no serrations.

Michaelsen goes on to suggest that my species is possibly identical with Rosa's *Acanthodrilus bovei*. I am not able, however, to adopt this suggestion, and for the following reasons.

In the first place *Acanthodrilus bovei* is a much smaller species than the one named by myself *Acanthodrilus falclandicus*; the measurements of *A. bovei* are 35 mm. in length by 3 mm. in diameter; *A. falclandicus* measures 60 mm. in length and upwards.

Of *A. bovei* the prostomium is said by Rosa to extend on to the buccal segment for about two-thirds of the length of the latter; the prostomium is less extensive in *A. falclandicus*.

The clitellum in *A. falclandicus* is quite complete, extending right round the body; in the species with which it is sought to identify my *A. falclandicus* there is a non-glandular triangular area reaching as far forwards as the xvth segment.

Acanthodrilus falclandicus possesses a pair of papillæ upon the xth segment which lie behind the ventral setæ—exactly behind them. In *A. georgianus* Michaelsen has described a similar pair of papillæ upon the tenth segment, but not anything is stated with regard to their position upon the segment except that they lie upon the seta-line 2. In *A. bovei* there are such papillæ, but they lie between the ventral setæ on segments x. and xi.; Rosa also speaks of an oval area occupying a median position upon the ninth segment.

These differences are, I think, sufficient to distinguish my species from Rosa's *Acanthodrilus bovei*¹, though doubtless the two are very nearly related. In my paper upon the anatomy of this form I referred to its occurrence in fresh water as well as upon the land; I have since re-examined more carefully the specimens which occurred in water, and I find that they are really different from *A. falclandicus*, though very nearly related; indeed the differences between all of these Patagonian *Acanthodrilidæ* are not very large.

¹ "I Lombrichi della spedizione antartica italiana del 1882," Ann. Mus. Civ. Genova, ser. 2 a, vol. vii. p. 143.

I name the species

6. *Acanthodrilus aquarum-dulcium*, n. sp.

I need not trouble to give a detailed description of this species, but will merely indicate the differences which it shows from *A. falclandicus*. It is in the first place a much smaller species; the measurements of a full-sized specimen are as follows:—Length 47 mm.; breadth 3 mm.; number of segments 90.

The species is altogether of a more slender build than *A. falclandicus* and has thinner body-wall. The two atrial pores of each side are connected by a groove in which lies the pore of the sperm-duct; this latter pore, as in *A. falclandicus*, is just outside the ventral setæ which are present upon the xviiith segment, though of course absent or perhaps rather replaced by the penial setæ on segments xvii. and xix. Between the ventral setæ on the xviiith and on the xxth segments are a pair of small papillæ. I did not find any papillæ in the neighbourhood of the spermathecal orifices.

The internal anatomy hardly differs from that of *A. falclandicus*; there are, however, no thickened septa; the sperm-sacs may be different, but I was not able to make out their arrangement accurately. I observed egg-sacs in segment xiv. The principal difference between this species and *A. falclandicus* concerns the penial setæ. In the present species they have only a very faint ornamentation at some little distance from the free extremity. The large tubercles characteristic of *A. falclandicus* are entirely absent; there are merely a series of minute spines with their apices directed downwards.

7. *Benhamia whytei*, n. sp.

Among a large quantity of insects and other invertebrates collected, for Mr. H. H. Johnston, C.B., by Mr. Alexander Whyte, F.Z.S., in Nyassaland was a single example of an Earthworm evidently belonging to the genus *Benhamia*, which I cannot identify with any of the African forms described by Michaelsen. The specimen was unfortunately not in a sufficiently good state of preservation to admit of an exhaustive account of its structure; but I have been able to ascertain some of the principal characters which serve to discriminate it from the other African species of the genus.

The specimen is $2\frac{1}{2}$ inches long and is of a dark brown colour.

The prostomium is not prolonged over the buccal segment; the dorsal pores commence very early between segments iii./iv.

The clitellum occupies segments xiii.–xix.; on the ventral side the male pores are surrounded by a circumscribed area, as in other species of the genus; within this area there is no development of glandular tissue.

The apertures of the atria are as usual upon segments xvii., xix.; the orifices are circular and each is surrounded by a circular rim; the two apertures of each side are connected by a groove; the ventral setæ of the three segments xvii., xviii., xix. are absent. Their place is taken on the xviiith and the xixth segments by the penial setæ.

The setæ are strictly paired and are on the ventral surface.

There are two gizzards, whose exact position I am not able to state.

The calciferous glands are kidney-shaped; there are three pairs of them, in segments xv., xvi., xvii. The intestine commences in the middle of segment xviii.

The dorsal blood-vessel is single; there are three pairs of hearts, in segments x., xi., xii.

Six septa following the gizzard are thickened, but their increase in thickness is not so well marked as it often is in Earthworms.

The internal anatomy of this species is precisely like that of *Benhamia crassa* above described; the form of the penial setæ, which are the only structures by which some of these *Benhamiæ* can be distinguished, were hardly different from those of *Benhamia crassa*; in the specimen from Dominica they were even twisted into a spiral at the extremity, there were possibly rather more denticulations on the end; in the same way the end of the two vasa deferentia of each side were enclosed in a common muscular sheath.

It may be that the glandular cæcum of the buccal cavity will prove to be a character of generic value. I followed out the ducts of the mucous gland, and find that each gland opens into the pharynx by a wide aperture, which has, however, a shorter duct than in *Octochætus multiporus*; the opening is also situated further back than in that genus; besides the opening into the buccal cavity, the mass of nephridial tubules, which I have called the mucous gland, also open on to the exterior by numerous openings.

I should mention that in this species, as in *B. crassa*, the last pair of hearts is in segment xii.

8. *Benhamia crassa*, n. sp.

Among a number of living Earthworms lately received from Kew, whither they had been accidentally transported from Lagos, West Africa, were two very small individuals, measuring about an inch in length after preservation, which apparently belong to two distinct species. Their appearance while alive was so very similar that I regarded them as of the same species, and proceeded therefore to examine one by means of a series of longitudinal sections, while the other was cut into two halves and the viscera teased out. I had hoped in this way to supplement by one method of study the results obtained by the other. The two individuals, however, turned out to differ in a slight degree, the difference being possibly of specific value; the difference mainly concerned the extent of the clitellum; in other points they appeared to agree.

The prostomium is imbedded in the buccal segment, but it is not continued by grooves over any part of this segment.

The dorsal pores begin between segments v./vi. if not earlier.

The clitellum commences in the hinder half of segment xiii., and extends until the xxist segment; only on the thirteenth segment is it developed over the ventral as well as the dorsal and lateral surfaces; in the remaining segments there is an area, occupying the whole of

the space between the ventral pairs of setæ, where there is no development of the clitellum at all.

The setæ are strictly paired and are all ventral in position; the distance between the two ventral pairs is about half again as great as that between a ventral and a lateral pair; there is no specialization of the setæ anywhere except upon the xviiith, xviiiith, and xixth segments; the ventral pairs of setæ are absent from all of these segments; on segments xvii. and xix. their place is taken by the penial setæ. I have already commented upon the apparently universal absence of the ventral setæ of segment xviii. in the genus *Benhamia*.

Between segments viii./ix. and ix./x. there is a single oval papilla lying in a position which corresponds to the interval between the two ventral pairs of setæ.

The oviducal pores lie in front of the outer of the two ventral setæ on each side.

The alimentary canal has two gizzards; there are the usual three pairs of calciferous glands in segments xv., xvi., xvii.; that section of the œsophagus from which they arise is of a very narrow calibre; but from the xviiiith segment the alimentary canal widens out very greatly and forms a dilated and thin-walled region without any typhlosole, which should perhaps be reckoned as belonging to the œsophagus. The intestine proper begins in segment xxii.; the buccal cavity is remarkable for the fact that it has a short cæcum on the dorsal surface, which differs from the rest of the buccal cavity in the character of its lining epithelium; the cells which constitute the innermost layer of this cæcum are like those of the epidermic layer; the cells are of two kinds, there being among them cells with clear contents and not staining deeply with borax carmine, which are exceedingly like the gland-cells of the integument. I comment later upon the similarity which this worm shows in the said particular to a representative of a totally distinct genus (*Microdrilus* ex fam. Cryptodrilidæ).

The nephridia in the posterior part of the body, that is to say behind the clitellum, are enveloped in a thick mass of vesicular cells, a condition which is very common among tropical Earthworms; the nephridia are of course "diffuse," and there is a mucous gland.

The reproductive organs show one peculiarity not common among Earthworms—the terminal part of the vas deferens is ensheathed in a muscular coat of some thickness; it is only from the xvith segment to the opening of the tube that this muscular coat is to be seen; the penial setæ are wavy at the extremity, being bent into a spiral with not very close coils; on the last bit of the seta are a very few denticulations with their apices directed forwards.

From Lagos I have also received examples of what I believe to be Michaelsen's *Benhamia bolavi*; this same species has also turned up from Dominica, Trinidad, Jamaica, St. Vincent, and, more remarkably still, from Seebpore, near Calcutta. I cannot distinguish any of these individuals from *Benhamia bolavi* as described by

Michaelsen¹. All of my specimens are excessively small, not measuring much more than an inch in length; this is about the size given by Michaelsen. They all have the single median oviducal pore, which not only distinguishes the species from the one just defined, but also from every other *Benhamia* except *B. gracilis*. This pore lies between the ventral setæ of segment xiv. I found the extent of the clitellum to vary somewhat; Michaelsen gives segments xiii.-xx. This was the case with the worms from Jamaica and with the single specimen from Seebpore; in the individual from Dominica the clitellum extended as far as the xxist segment, commencing with the xiiiith; in the specimen from Lagos, on the other hand, the clitellum was less extensive, viz. xiv.-xviii.

II. Family CRYPTODRILIDÆ.

9. *Microdrilus saliens* (sp. et gen. nov.).

I have had about a dozen specimens of this small Earthworm for examination; they were picked out from earth that arrived at Kew Gardens from Singapore; another individual turned up from Java and others from Penang. The small size of the species suggested the generic name; the largest individuals are in alcohol hardly more than an inch in length. During life the species is, like *Perichaeta*, remarkable for its extreme agility; when touched they twist themselves violently from side to side and can often spring for a short distance above the table. The worms were preserved in corrosive sublimate and acetic acid, followed by increasing strengths of alcohol, and were investigated by transverse and longitudinal sections. The genus belongs to the family Cryptodrilidæ as defined by myself². Though I have examined a considerable number of individuals, the presence of sand in the intestines spoilt a good many of the sections; hence my account of the anatomy of what is in all probability a new genus in less than it should be. As, however, the worm shows one feature of some little interest, I have thought it worth while to add to the present paper such notes as I am able to give.

There are two gizzards, which follow each other almost immediately and are only separated by the slightest constriction. In segments xv., xvi., and xvii. lie the calciferous glands; these have the usual structure and contain large rhomboidal crystals. Their connexion with the œsophagus is interesting; each pouch does not, as is generally the case, open into the gut; there is only one duct on each side communicating with the œsophagus. It lies just behind the septum separating segments xv./xvi.; the two remaining pouches of each side communicate with the middle pouch, which alone has

¹ "Oligochaeten des Hamburger naturhistorischen Museums, iv.," JB. Hamb. wiss. Anst., Bd. viii.

² "Terricolen der Berliner zoologischen Sammlung," Arch. f. Nat., Bd. 1892.

² "The Classification and Distribution of Earthworms," Proc. Roy. Phys. Soc. Edinb. 1890, i. p. 236.

an opening into the gut. This arrangement, however, occurs in *Lumbricus*, where it was first, I believe, accurately described by Messrs. Marshall and Hurst in their 'Practical Zoology'; but it has not been described in any other genera, and most certainly does not exist in many Earthworms, e.g. *Pontoscolex* (= *Urochæta*), where each gland opens by its own duct into the œsophagus. The calciferous gland of the xvth segment has a rather smaller development of the internal folds; the duct leading to the œsophagus is ciliated. The intestine begins in the xviiiith segment.

Another feature of interest in this genus concerns the male efferent apparatus, which differs in detail from that of many other Earthworms; the male pores are upon segment xvii. within the ventral pair of setæ; each aperture is really double, though this point is not recognizable without having recourse to section-cutting. The two apertures of each side are enclosed by the swollen epidermis, of which the cells are very elongated and at the same time narrow; one aperture lies in front of the other; the anterior of the two is connected with the atrium, and through it project a few penial setæ which are enclosed in a muscular sac; these penial setæ have the form illustrated in Plate XLVI. fig. 13. The atrium is not in any way remarkable; it belongs to the tubular type and is divided, as in *Acanthodrilus*, &c., into a granular and a muscular portion. The vas deferens near to its external opening, in fact from segment xv. onwards, is enveloped by a thick muscular coat which is fully as thick as is that of the atrium. I have already described in *Pygmæodrilus* a similar muscular investment of the terminal region of the sperm-duct; and I have met with the same thing in two species of *Benhamia* described above.

The nephridia of this worm are diffuse. The position of the male pores distinguishes the genus from *Digaster*, in which the male pores are upon segment xviii. On the other hand, it is quite possible that it is congeneric with *Dichogaster* as extended by Michaelsen to include his new species *D. minus* and *D. huyferi*. The particular points referred to in the above description are not mentioned by Michaelsen; accordingly it is uncertain how far I am justified in creating a new genus.

III. Genus PERIONYX.

This genus was founded by Perrier¹ for a worm closely related to *Perichæta*, but differing from that genus by "the development of the clitellum, the arrangement of the male orifices, the position of the spermathecæ, and finally the clearness of the segmental organs." Although the investigations of *Perichæta* which have been carried out since Perrier's paper was published have led to a necessary alteration of the wording of the above quoted phrase, there is every reason to agree with Perrier in holding the genus *Perionyx* as distinct from *Perichæta*. There is at present no reason for

¹ "Recherches pour servir à l'histoire des Lombriciens, &c.," *Nouv. Arch. du Muséum*, t. viii. p. 126.

uniting, as Perrier thought might be eventually necessary, the two genera *Perionyx* and *Perichæta*. Vaillant in thus uniting these genera errs, in my opinion, as much on the one side as does Benham¹ on the other, when he relegates the two to different families.

I have recently studied four species of *Perionyx*—one of which I referred to some years since in connexion with the remarkable variations in structure exhibited by individuals; the second species, of which I owe examples to the kindness of Dr. Michaelsen, has been lately described by that naturalist² as *Perionyx gruenewaldi*. The specimens of the two remaining species were sent to me some time since by the kindness of Dr. King; they are from Seebore. Putting together what we know from Perrier's investigations, from my own^{3, 4}, from those of Michaelsen⁵, Rosa⁶, and Bourne⁷, and what I have to say here with regard to this genus, we may thus define it:—

Genus *Perionyx*, Perrier.

Perionyx, E. Perrier, Nouv. Arch. Mus. t. viii. p. 126.

Setæ forming complete circles, present as such upon all the segments of the clitellum; male pores close together upon a depressed area on segment xviii., with a group of modified setæ in some species near to each orifice; atria lobate; spermathecae two (or three) pairs in (vii.) viii., ix., with or without diverticula; nephridia paired; no specially thickened septa; no cæca.

The above definition of the genus may now be supplemented by a few remarks. These remarks will chiefly concern the species of the genus; the type species, *P. excavatus*, has been described by Rosa as well as by Perrier, and to a more limited extent by myself. But I am not quite certain, after comparing two out of the three species described here in addition to Michaelsen's *P. gruenewaldi*, as to which of them is really Perrier's *P. excavatus*.

The worms from Manila agree very closely with Michaelsen's *P. gruenewaldi*. Michaelsen distinguishes his species from that of Perrier on the following grounds:—The pigmentation is so marked that, if *P. excavatus* were of the same dark violet colour above, Perrier would hardly have omitted to notice the fact; secondly, the perial setæ of *P. gruenewaldi* appear to distinguish it from *P. excavatus*; thirdly, the position of the gizzard; this organ is fixed by Perrier in the twelfth segment; Michaelsen, on the other hand,

¹ "An Attempt to Classify Earthworms," Q. J. M. S. vol. xxxi. p. 247.

² "Oligochaeten des Hamburger naturhist. Mus. iv.," JB. Hamb. wiss. Anst. viii. p. 33.

³ "Descriptions of some new or little-known Earthworms, &c.," P. Z. S. 1886, p. 308.

⁴ "Note on some Earthworms from India," Ann. & Mag. Nat. Hist. ser. 5, xii. p. 217 (1883).

⁵ "Beschreibung der von Herrn Dr. Fr. Stuhlmann auf Sansibar, &c.," JB. Hamb. wiss. Anst. ix.

⁶ "Perichetidi di Birmania," Ann. Mus. Civ. Genova, ser. 2 a, vol. vi. p. 157.

⁷ "On Indian Earthworms," P. Z. S. 1886, p. 662.

finds that in his species the gizzard is a mere rudiment in the fourteenth segment, in front of which (in segment xiii.) are a pair of calciferous glands not referred to by Perrier.

In all these points, with one exception, my "*Perionyx excavatus*" agrees with Michaelsen's species; I can distinguish no marked difference of any kind between these worms, except in size, and the size is after all not so marked as to lead to the opinion that it is an index of specific distinction—110 mm. as compared to 85 mm. In the more detailed description which follows of the male pores there may indeed appear to be a little difference, but I am uncertain how far to refer this to defective preservation of the *P. gruenewaldi*. The exception to which I have referred concerns the gizzard; this organ in the worms examined by myself and referred to Perrier's *P. excavatus* is rudimentary indeed, but such as it is it appears to lie in the sixth segment, as it does in the two other species to be described presently.

Rosa gives some account of a worm from Burmah¹ which he identifies with *Perionyx excavatus* of Perrier; he points out that the gizzard is situated anteriorly, and not, as Perrier stated, in the xiiith segment; Rosa, however, makes no mention of the calciferous glands, nor of the genital setæ. The description of the male pores agrees with Perrier's description and with the appearance of these pores in the worms which I am disposed to identify with Perrier's *Perionyx excavatus*. A very characteristic feature of the latter was the absence of any diverticulum of the spermatheca; with regard to *Perionyx excavatus* Perrier remarks (*loc. cit.* p. 129), "les poches copulatrices sont situées dans les anneaux sept et huit; elles m'ont paru formées d'un simple sac piriforme." I take it that this sentence implies the absence of any diverticula. On the other hand, Michaelsen refers to diverticula in his *Perionyx gruenewaldi* and *P. sansibaricus*. This seems, at any rate, to be a good distinction between the two species.

I have received from Seebpore examples of a species of *Perionyx* which appears to be different from *Perionyx excavatus*; it is certainly different from the worms identified as such by myself; but as Perrier's account is incomplete in one or two points, it is a little difficult to be absolutely certain. These examples were rather stouter in build than the Manila worms, and the coloration was a little less marked; this, however, may be the effect of the corrosive sublimate used in the preparation of them. In the internal anatomy this species is to be distinguished by five differences from the Manila species; these are as follows:—

The gizzard is fairly well marked and lies in the vith segment; there are no calciferous glands at all, though the œsophagus is somewhat folded and vascular posteriorly. The last pair of hearts lie in the xiiith segment; in the form from Manila the twelfth segment is the last which contains a pair of hearts; nothing is said upon this point by either Perrier or Rosa. The spermathecae are, as in the other species (excepting *P. sansibaricus*), two pairs and they

¹ *Loc. cit.*

occupy the same segments, but each has a small irregularly shaped diverticulum sessile upon the duct of the spermatotheca. Finally, the atria are much larger than they are described in *Perionyx excavatus* or than they are in the species which I here identify with Perrier's *Perionyx excavatus*; they are much broken up into lobes and extend through three segments; the duct, too, is longer and is contorted; these glands in fact resemble very closely those of a typical *Perichæta*.

Some years ago I briefly described a species of *Perionyx* from Akyab¹ to which I gave the name of *Perionyx macintoshii*; this species is admitted by Vaillant², but not very heartily allowed by Rosa³.

I have got two individuals of a large *Perionyx* which I believe are referable to the same species; if so it is certainly a "good species."

My observations upon *Perionyx macintoshii* were made upon a single, not sexually mature, example; they were therefore not quite conclusive as to the distinctness of the species, though the large size alone is, as it proves, a sufficient index of the species, when compared with the three others described here.

The internal anatomy is more like that of the first species from Seebpore, which I propose to term *Perionyx intermedius*; the last pair of commissural vessels are in the xiiith segment; the atria, however, are limited to a single segment, and the spermatothecæ have no appendix. The principal differences concern the external characters; this species has a more extensive clitellum, it reaches from the xiiith to the xixth segment, being thus longer by two segments than in the other species; the male pores have not, as I pointed out in my earlier description of the species, the characteristic appearance of those of *Perionyx excavatus*; they are placed in a ventral area, but the two pores are not upon separate papillæ. The four species of *Perionyx* referred to in this paper show certain very characteristic differences in the condition of the male pores and of the setæ in their immediate neighbourhood, of which the following is an account.

In *Perionyx gruenevaldi* the area upon which the atrial pores are borne is not, owing to the small size of the worm, very well marked when looked at through a lens. When this part of the body is submitted to a microscopic examination, the area is seen to be bounded by an obvious groove. The ordinary setæ of this segment (the xviiith) do not extend on to this area except on one side of the body, where a single seta is inserted on to the outer edge of the area; as, however, a groove cuts off the tract of integument which bears this seta from the genital area, it might be held that the line between the genital area and the surrounding integument was indicated by this groove. There are four genital setæ on each side which, although

¹ "Note on some Earthworms from India," Ann. & Mag. Nat. Hist. ser. 5. xii. p. 217 (1883).

² Annelés in 'Suites à Buffon,' p. 86.

³ "Porichetidi di Birmania," Ann. Mus. Civ. Genova, ser. 2a, vol. vi. p. 157.

close together, are really in a line which is in the same direction as the circle of setæ of the segment; there is, however, a gap between the last seta of the ring of unmodified setæ and the first of the genital setæ. The atrial pores are just in front and to the outside of the groups of the genital setæ. The setæ themselves have been figured by Michaelsen.

In *Perionyx excavatus* the male genital apertures are each placed upon a semicircular elevation, the two being in close contact. These flat papillæ are both depressed below the surface of the surrounding integument; this depressed area appears to be only sharply marked off anteriorly and posteriorly by grooves; laterally there is no sharp demarcation, the papillæ gradually rising until they attain the level of the surrounding integument. Each papilla has 5 or 6 genital setæ of a precisely similar appearance to those of *Perionyx gruenewaldi* just described; they are arranged in the same way, being continuous with the line of setæ of the segment and are separated from them by a space. These genital setæ are also longer than the ordinary setæ of the body, but the latter show a certain amount of ornamentation, which was specially marked in the case of the ventral setæ of segment xix.

In *Perionyx macintoshii* the ventral area which bears the atrial pores forms a sucker-like structure completely sunk below the level of the surrounding epidermis; it measured in one individual 3 mm. across. This difference from the other two species may possibly be correlated with the fact that in *Perionyx gigas* the clitellum extends beyond the male apertures.

In *Perionyx intermedius* the arrangement is rather different from that which obtains in the two species just described. The xviiiith segment is widened in the middle ventral line; the integument has a tumid swollen appearance, and there is a transverse groove into which open the atrial pores. The row of setæ of this segment are not continued over the median area, but in one specimen I observed two setæ, one on each side at the bottom of the groove already referred to. As the extremities of these were unfortunately broken off I am not able to say whether they showed any more marked ornamentation than the other setæ of the body; in any case they were not different in form.

It will be seen from the above details that the genus, as we at present know it, falls into two subdivisions. In *Perionyx macintoshii* and *P. intermedius* there are no specially modified setæ in the neighbourhood of the male pores, and the latter are placed upon a median area which is not divided by a cross furrow into two areas, one for each pore.

In *Perionyx excavatus* and *P. gruenewaldi* there is a group of specially modified setæ near to each male pore, and these pores are placed each upon a separate papilla, both papillæ being enclosed within an area marked off from the surrounding integument.

It appears to me that in this genus we have an early stage in the evolution of the penial setæ of other types—*e. g.*, the genus *Megascolex*; if the modified setæ of *Perionyx excavatus* were withdrawn

from the exterior of the body and lodged in a sac formed by their withdrawal, we should have the sac of penial setæ such as occurs in so many Earthworms. *Perionyx macintoshii* is in an earlier stage still; the setæ in the neighbourhood of the male pores are not modified, but appear to resemble those of other segments. Finally the four species may be thus briefly defined. (I have not included Bourne's *Perionyx saltans* pending further details, or Michaelsen's *P. sarsi-baricus*, which seems to resemble it in the alternation of the nephridia and may be identical.)

10. *Perionyx excavatus*, E. P.

P. excavatus, E. Perrier, Nouv. Arch. Mus. t. viii.

P. excavatus, F. E. Beddard, P. Z. S. 1886, p. 308.

Megascolex excavatus, L. Vaillant, Annelés, t. iii. p. 69.

Length 110 mm.; breadth 4 mm.; number of segments 165.

Colour (in spirit) purplish on the dorsal surface, yellow beneath; clitellum yellowish brown.

Clitellum occupying segments xiii. (xiv.)-xvii.

Setæ: on either side of male pores about 5 longer setæ with strong ridges at free extremity; these lie within the area surrounding the male pores.

Dorsal pores commence v./vi.

Gizzard very slight in xii.; a single pair of calciferous glands in xiii.; intestine begins in xvii.; œsophagus widens out in xii., but becomes narrow again in xiv.

Last pair of hearts in xii.

Sperm-sacs very extensive, x.-xiii.

11. *Perionyx intermedius*, n. sp.

Length 105 mm.; breadth 5 mm.; number of segments 117.

Colour (in spirit) with a faint purple tinge dorsally, not nearly so marked as in preceding species.

Clitellum xiii.-xvii.

The pit on segment xviii. bearing the atrial pores is shallow and not very marked; the two pores lie in a transversely running groove and the integument is thrown into a series of folds on either side of the groove.

Gizzard in vi., not at all prominent. No calciferous glands. Intestine begins in xviii.

Last pair of hearts in xiii.

Spermathecae in viii., ix., each with a small globular diverticulum sessile upon the duct.

Atria very large and of a loose consistency, extending through three segments, xvii.-xix. Duct comparatively long and coiled.

12. *Perionyx macintoshii*, F. E. B.

? *P. macintoshii*, F. E. Beddard, Ann. & Mag. Nat. Hist. ser. 5, xii. p. 217.

Length 249 mm.; breadth 9 mm.; number of segments 261¹.

¹ 320 mm. in length; 244 segments in another specimen.

Colour (in spirit, and after corrosive sublimate) purplish on the dorsal surface and yellow beneath; clitellum yellow.

Clitellum xiii.-xix.

On segment xviii. an oval depression 3 mm. wide round the male pores which lie behind the setæ; the latter are less modified than in *P. excavatus*.

Oviducal pore single and median, in front of setæ of segment xiv.

Dorsal pores commence v./vi.

Gizzard in vi.; intestine commences in xix. No septa very much thickened.

The last pair of hearts is in segment xiii.; the first pair of commissural vessels in vi.

Sperm-sacs in x.-xii.

Nephridia commence in segment iii.

IV. Genus MONILIGASTER.

13. *Moniligaster bahamensis*.

This genus and the closely allied *Desmogaster* of Rosa have been hitherto only discovered in the tropics of the Old World; India, Burma, Japan, and the islands of Luzon, Ceylon, and Sumatra have yielded all the known species. In the present paper I describe a form which I received alive together with a number of other species from Kew, whither it had been imported accidentally with plants from the Bahamas.

The worm is small and slender, measuring about 25 mm. in length. Although this interesting genus has been now so frequently studied, there yet remain a few points upon which further information is desirable: some of the hitherto missing information I am able to supply in the present paper. The genus is chiefly interesting on account of the fact that it upsets in so many points the old distinction between "Terricolæ" and "Limicolæ." Though terrestrial in habit and in general appearance the anatomical structure is in many respects that of certain aquatic Oligochæta. Our present information upon the genus is derived from the following memoirs:—

- (1) F. E. BEDDARD.—"Note on some Earthworms from Ceylon and the Philippine Islands." *Ann. & Mag. Nat. Hist.* ser. 5, xvii. p. 89 (1886).
- (2) F. E. BEDDARD.—"Note on the Reproductive Organs of *Moniligaster*." *Zool. Anz.* Bd. x. p. 678.
- (3) F. E. BEDDARD.—"On the Structure of three new Species of Earthworms, with Remarks on certain points in the Morphology of the Oligochæta." *Q. J. M. S.* vol. xxix. p. 119.
- (4) F. E. BEDDARD.—"Preliminary Notes on Oligochæta. (3) Note on *Moniligaster*." *Zool. Anz.* Bd. xii. p. 533.
- (5) F. E. BEDDARD.—"Observations upon the Structure of a Genus of Oligochæta belonging to the Limicoline Section." *Tr. R. Soc. Ed.* vol. xxxvi. pt. i. no. 1.
- (6) A. G. BOURNE.—"On Indian Earthworms: Pt. I., Prelim-

- inary Notice of Earthworms from the Nilgiris and Shevaroy's." P. Z. S. 1886, p. 670.
- (7) R. HORST.—"Descriptions of Earthworms.—I. *Moniligaster houtenii*, n. sp., a gigantic Earthworm from Sumatra." Notes Leyd. Mus. vol. ix. p. 97.
- (8) E. PERRIER.—"Recherches pour servir à l'histoire des Lombriens terrestres." Nouv. Arch. Mus. vol. viii. p. 130.
- (9) D. ROSA.—"Viaggio di Leonardo Fea in Birmania e Regioni vicine: xxv. Moniligastridi, Geoscolecidi ed Eudrilidi." Ann. Mus. Civ. Genova, ser. 2 a, vol. ix. p. 368.
- (10) W. MICHAELSEN.—"Terricolen der Berliner Zoologischen Sammlung." Arch. f. Nat. 1892, p. 209.

In this list, it should be mentioned, I have only included papers containing new facts with reference to the genus; other papers which refer to it will be quoted in their place in the course of the following pages.

External Characters.

In the present species, which I name *Moniligaster bahamensis*, the clitellum was fortunately developed; it was not, however, visible until the worm was examined by means of sections, and was then found to occupy four segments, viz. x.-xiii. It will be remembered that Perrier created a special group, the *Achitelliens*, for *Moniligaster*, since it appeared to possess no clitellum; the anterior segments were, however, described as resembling in certain particulars the clitellum of other worms and as probably representing that organ; but it is not necessary to remark that frequently the anterior segments of Earthworms, especially of the smaller species, are considerably thicker, and also appear more opaque owing to the enclosed viscera. The first to describe the clitellum was Prof. Bourne; he wrote that it occupied segments x.-xiii.; but there are no details given as to whether the clitellum was visible without first having recourse to section-cutting; it certainly is not in the present species. The clitellum begins and ends sharp at the margins of the segments which it occupies. The resemblance which the forward position of the clitellum in *Moniligaster* gives this genus to the Lumbriculidæ need not be again emphasized; I have already sufficiently dwelt upon the matter.

I have, however, now to refer to an interesting point with regard to the clitellum which has not yet been described: the minute structure of the clitellum differs from that of all other Earthworms and agrees with that of all "Water-worms" in being composed of a single layer of cells only. This appears to me to be a point of great importance; coupled with the position of the clitellum it gets even greater importance than it would otherwise have. Rosa has sought to minimize the significance of the anterior position of the clitellum; but I do not think that anyone will deny that the resemblance in structure which it shows to the lower Oligochæta cannot be explained away; there is, moreover, no resemblance in

habit which might perhaps discount the value of the characters afforded by the clitellar epithelium. Although the clitellar epithelium is only one cell thick, it is made up of cells of two kinds: there are large non-staining cells, imbedded among smaller cells loaded with darkly staining granules. Plate XLV. fig. 5 illustrates the structure of the clitellum, which, as will be seen, is not very much thicker than the epidermic tissue of adjacent segments not modified.

The setæ, as in other species, are strictly paired; I could find no setæ upon the second segment of the body: I have already mentioned that in *M. barwelli* these setæ are very small and easy to be overlooked; I could not find the least trace of them in the present species.

The muscular layers of the body-wall are remarkable in certain points. The circular layer, as is shown in fig. 5, does not extend quite up to the longitudinal layer: between the two is a space occupied by a delicate connective tissue with interspersed nuclei; in this layer run the nerves, of which there are three main trunks in each segment. The muscle-fibres, when seen in transverse section, show the characteristic appearance of the muscular fibres of the Leech in a more distinct way than I have ever noticed in any Oligochætous worm: the layer of muscular substance in each fibre is very narrow as compared to the central cavity, which is filled by a faintly granular matter; this is not stained; the fibres differ greatly in diameter, the smaller ones being nearest to the epidermis. One might perhaps speak of the layer which lies between the circular and longitudinal muscles as a "nervous layer"; it contains many small nerve-twigs besides the main trunks already referred to. The longitudinal muscular layer is, comparatively speaking, narrow; its fibres tend to be arranged in the bipinnate fashion which is so common, though not universal, among the higher Oligochæta. Here also it was easy to see that each fibre has a central soft core. On the whole the structure of the body-wall of the Annelid, with the exception of course of the clitellum, is like that of Earthworms rather than the aquatic genera; but *Phreocyctes*, which Claparède ranged among his "Limicolæ," has a body-wall which is also like that of the higher Oligochæta; so that this point of resemblance is not conclusive as to the affinities of *Moniligaster*.

Internal Anatomy.

The internal structure of this new species of *Moniligaster* is not widely different from that of *Moniligaster barwelli*; there are four thickened septa which divide segments v./ix. Probably the existence of this number of septa is a character of generic importance, as they seem to occur in *M. beddardi* as well as in the two species referred to. The alimentary canal, again, presents no differences from that of other species; there are no calciferous glands, and there appears to be no vascular tract of the œsophagus which in so many Oligochæta replaces functionally these glands; the usual three gizzards are present, commencing in the xiiith segment. The nephridia have a large cæcum as in other species; I observed the

funnel of the nephridia, which lies in the segment in front of that which contains the rest of the nephridia. The structure of the nephridia is not that of the aquatic Oligochaeta; they recall those of the Geoscolecidae. It is of course the reproductive organs which are so different from those of the higher Oligochaeta.

The testes, as in the other species of the genus, are placed within the sperm-sacs attached to the front wall of segment x.; they are also in contact with the ciliated rosettes, which open likewise into the interior of the sperm-sacs. In *Moniligaster barwelli* I figured and described the ciliated rosettes as lying in the same segment as that upon which the atria open on to the exterior; this is also the case with *M. beddardi* and with the species described in the present paper; in those two *Moniligasters* the sperm-duct is very short and lies entirely within the xth segment. In *M. bahamensis* the sperm-ducts are remarkably long and much convoluted, recalling the sperm-ducts of such genera as *Pachydriilus*; they do not lie entirely within the xth segment but extend forwards into the segment in front. It is quite possible that the difference is merely one of maturity in the various individuals. The arrangement of the sperm-ducts is, curiously, the reverse of the arrangement characteristic of the posterior sperm-duct of the Lumbriculidae; in these worms the sperm-ducts in question traverse the septum lying behind the male pore, and then bend back to traverse the same septum again. This is exactly what occurs in *Moniligaster bahamensis*, only that it is the segment in front of that which bears the male pores which is twice perforated by the sperm-ducts. I do not, of course, intend a serious comparison between the two forms in this matter; but at any rate the disposition of the sperm-ducts in *Moniligaster* is exceedingly different from anything that occurs in the remaining genera of Earthworms.

The sperm-sacs in the present species are restricted to the xth segment; this was the case at any rate with one of the two species which I studied by means of longitudinal sections; the segment in which they lie is the xth; as in the other species of the genus, their cavity is undivided by trabeculae, but filled with developing sperm.

The orifices between segments x./xi. lead into a pair of muscular sacs; each sac has a narrow lumen bordered by a single layer of low columnar cells covered with a moderately thick chitinous layer; outside the epithelium is a mass of muscles which are somewhat loosely arranged, and in the interstices of which lie groups of glandular cells. The sac is oval in form and at the distal end the lining epithelium is reflected back over a conical process which contains the duct of the atrium proper; *the terminal sac with this evidently protrusible structure has clearly the closest possible resemblance to the penis and penis-sheath of the Tubificidae*. Vejdovsky has figured¹ a protrusible penis in the Lumbriculid *Stylodrilus*—a family which is in some respects nearer to *Moniligaster* than are the Tubificidae. Among Earthworms the nearest approach to the penis

¹ System. u. Morph. Oligochaeten, pl. xi, figs. 11-16.

of the aquatic Oligochæta and of *Moniligaster* is to be seen in the genus *Eudrilus*. But *Moniligaster* obviously comes much closer to the aquatic Oligochæta than does *Eudrilus* in this particular.

Communicating with this muscular penis is the atrium. I have already described and figured the structure of the atrium in *Moniligaster barwelli*, and have pointed out its close similarity to the atrium of the Lumbriculidæ; the Tubificid *Branchiura* has an atrium which is also constructed upon the same plan. In *Moniligaster bahamensis* we have the same low and darkly staining columnar epithelium lining the lumen; this is surrounded also by the same comparatively thick circular muscular layer; in *M. bahamensis*, as in *M. barwelli*, the outermost covering of the atrium is formed by oval groups of pear-shaped cells. I find, however, that in the species of *Moniligaster* with which the present paper deals, the ducts of these cells, which are simply filiform prolongations of their substance, pierce the muscular layer in bundles and evidently pour their secretion into the lumen of the atrium. These ducts were exceedingly conspicuous owing to their dark staining, an effect possibly due to the presence of abundant secreted granules. They were probably overlooked in *Moniligaster barwelli*, owing to their not being stained. I could find no peritoneal layer even of the thinnest round the atrium.

Rosa has described a somewhat different structure for the "prostates" (atria) of *Desmogaster*. He has above all insisted upon the presence of a peritoneal layer investing the organ superficially. The minute structure is described in the following words:—"Il lume interno è piccolissimo, appena $\frac{1}{10}$ del diametro; esso è tappezzato da un epitelio cilindrico. Esternamente a questo la massa delle pareti è prevalentemente muscolare; nella parte più centrale le fibre sono annulari; in tutto il resto sono longitudinali, disposte in fasci ragianti. Nella regione più esterna questi fasci divergendo racchiudono fra di loro delle ghiandole pluricellulari piriformi che per lunghi condotti vanno a raggiungere il lume interno, ma queste ghiandole non arrivano alla parete esterna della prostata perché i fasci muscolari, benché ridotti a sottili striscie, passano fra una ghiandola e l'altra e si ricongiungono fra loro, formando spesso solo un sottile rivestimento attorno alla base di esse. E inoltre ben evidente un rivestimento esterno peritoneale che spesso nelle sezioni si vede staccato. La superficie delle prostate non è racemosa come nei *Moniligaster*, ma liscia o appena ondulata, ed ha lo stesso aspetto sericeo delle prostate degli *Eudrilus*." This description and the illustrative figure are suggestive rather of the penis than the atrium of *Moniligaster*, particularly with regard to the gland-cells imbedded among the muscles. It appears to me to be possible that *Desmogaster* differs from *Moniligaster* in that the atrium is not specialized into two regions.

The ovaries are in the xith segment, attached to the front wall of that segment, as is so usual; the oviducal funnels open opposite to them and appear to be particularly large; but the most remarkable feature of the female reproductive organs of this Annelid are

the large egg-sacs. Even Rosa, who is so anxious to minimize the affinities of the Moniligastridæ to the lower Oligochæta, admits that the size of the eggs-sacs is unknown in the Terricolæ, though it is, he remarked, going rather too far to exclude *Moniligaster* from the Terricolæ on these grounds. In *Moniligaster beddardi* no egg-sacs were found by Rosa; but I do not think that this failure to find the structure in question is tantamount to a proof that they are non-existent in that species, as Rosa seems to imply. Anyhow they are large in the present species, and occupy at least three segments. Bourne, the first to discover these bodies, stated that they occupy in *Moniligaster minutus* segments xii.-xv. As to the ova of *Moniligaster*, Bourne says nothing about them save that there are ova in these sacs; the eggs in *Moniligaster beddardi* are, according to Rosa, very minute. In the species here under consideration the ova present a very remarkable character, unique among Earthworms: they are not particularly large, though, perhaps, larger than in many Earthworms; the remarkable fact about them is that they are crowded with yolk-particles: to so great an extent is the yolk developed that the nucleus is by no means always apparent; the yolk-particles are moreover, as is shown in the accompanying figure (Plate XLV. fig. 1), of considerable size, quite as large as they are in eggs of a much greater size. This fact about the ova of *Moniligaster bahamensis* is of considerable interest. I pointed out some time since¹ that the only distinguishing characters between the Megadrili and the Microdrili of Benham², not alluded to by Benham himself, are the three following:—

- (1) Large size of ova.
- (2) Clitellum consisting of only a single layer of cells.
- (3) Sexual maturity at a fixed period.

In the three points mentioned the Microdrili (= Limicolæ of Claparède minus Nais and *Æolosoma*) differ from all the Megadrili or Earthworms. Now I have just pointed out that the ova of *Moniligaster*, although not so large as they are in the Microdrili, agree with them in having a great quantity of yolk, a character not found in any other Earthworm; this is, at any rate, an indication of a step in the direction of the Microdrili, even if it be not held to be a point of close affinity with them. On a previous page I have pointed out that the structure of the clitellum is quite like that of the lower Oligochæta in being made up of a single layer of epithelium only; it may be added that in all possibility the sexual maturity is at a fixed period; this would account for the failure of so many investigators to find the clitellum; Prof. Bourne tells me that he expects that the clitellum will be found at the proper season in all Moniligasters.

It is difficult therefore to see on what grounds *Moniligaster* is to be referred to the Earthworms as opposed to various groups of the aquatic Oligochæta. Rosa justly points out that *Tetragonurus*

¹ "On the Anatomy of *Ocnerodrilus* (Eisen)," Trans. Roy. Soc. Edinb. vol. xxxvi.

² "An Attempt to Classify Earthworms," Q. J. M. S. vol. xxxi.

probably, and *Allurus* certainly, have the male pores situated very far forwards, nearly as far forwards as in *Moniligaster*; this he holds renders it unnecessary to lay any particular stress upon the forward position of the pores in question, in *Moniligaster*, as an indication of affinity with the lower Oligochæta. Granting this for the moment, it seems a little unfair that Rosa should use precisely the same character as an indication of affinity with the Lumbricidæ, especially with the two genera just mentioned. On p. 386 of his memoir, however, he states, as a feature of resemblance between *Moniligaster* and these genera, the fact that in both the male pores are in front of the oviducal pores.

As to the forward position of the clitellum in *Moniligaster*, Rosa quotes the instance of *Buchholzia appendiculata*, where the organs of the body are two segments in front of the usual position which they occupy in allied species. I do not think from what we now know that it will prove to be the case that in any species of *Moniligaster* the clitellum is so far back as segments xii.—xv., a position which, as Rosa justly points out, is after all not so very different from what we find in other undoubted Earthworms. The new facts contained in the present paper do not furnish any material for a renewed discussion as to what group of Earthworms comes nearest to the Moniligastridæ: the only pronounced feature in which they resemble any Earthworms is the presence of several gizzards lying at the end of the œsophagus; but we now know that this character is found in several genera belonging to at any rate three families, viz., *Pleionogaster*, *Bilimba*, and the three Eudrilids *Hyperiodrilus*, *Heliiodrilus*, and *Libyodrilus*. This character, therefore, must be neglected as a mark of affinity.

V. Family EUDRILIDÆ.

14. *Eudriloides durbanensis*.

The division of the Eudrilidæ into genera requires some further consideration; we are at present but imperfectly acquainted with a large proportion of the many forms recently described from tropical Africa by Dr. Michaelsen; and as there are doubtless a large number of forms awaiting discovery, it is also premature to attempt any systematic revision of the family. I therefore refer provisionally the species, which I describe in the present paper, to the genus *Eudriloides*, without pretending that it may not ultimately be transferred to some other genus; I give at the end of the description my reasons for this course.

The worms which I describe here were obtained from Kew Gardens; they had reached those gardens from Durban, Natal; I preserved them in alcohol after killing them in weak spirit. There were five specimens, of which two were studied by longitudinal sections, the others examined in glycerine. The species is a small one; the length is about two inches by a breadth of not more than two millimetres; the worms are therefore long and slender. During life the colour was red—a colour owing, of course, to the absence of

integumental pigment and to the consequent visibility of the blood-vessels through the skin.

The setæ are strictly paired. The clitellum is not developed ventrally, it extends dorsally over four segments, viz. xiv.-xvii; the male pore is single and median upon segment xvii. near to the posterior end of that segment; the spermathecal orifice is also single and upon the xiiith segment.

There are a few papillæ present; on the eleventh segment are a pair on each side of the median ventral line; on the fifteenth segment are another pair occupying a corresponding position; finally there are two pairs on segment xiii., one pair in front of and one behind the spermathecal orifice; in sections these papillæ are seen to be slight depressions of the integument, and the epithelium is deeper than that which covers the body generally; it is also composed of large clear cells which have a glandular appearance. It is possible that the papillæ are adhesive disks, and not, as they seem frequently to be in some other Oligochæta, sense-organs.

A very marked peculiarity of the family Eudrilidæ is the presence in the skin of those peculiar sense-bodies which were first described by myself in *Eudrilus*, and have since been found in a few other genera of the family; they are, however, by no means universal, but have never been met with in any worm not belonging to the family Eudrilidæ: they occur in the species under consideration. I only observed them in the clitellar region; this was perhaps due to the fact that elsewhere they were not so readily visible owing to the thinness of the epidermic layer; they lie in the clitellum beneath the epidermis, and are placed longitudinally with reference to the long axis of the body.

The muscular layers are not very thick; but there are no noteworthy points to comment upon.

With regard to the internal anatomy, the alimentary tract shows a peculiarity not hitherto described in any Eudrilid: in many genera of this family there are calciferous glands of two kinds—paired organs in segment xiii., and ventral unpaired pouches in segments ix., x., xi. The present species has neither of these two kinds of appendages; but it is not, as are many forms (e. g. *Libyodrilus*), entirely without glands appended to the œsophagus.

In segments vi.-x. there are pairs of whitish-coloured glands which have a remarkable structure, quite unusual and unparalleled in the group Oligochæta (see, however, the following description of *Trichochæta barbadensis*). One of these glands is illustrated in fig. 11 of Plate XLVI.; the gland is of an oval or sometimes a more irregular shape; it is bounded externally by a thin layer which stains darkly with borax carmine, and which is perhaps to be regarded as the peritoneal layer investing the gland externally; within this there is a mass of tissue consisting of innumerable spherules like the yolk-spherules of an ovum, and, like them, not stained by the reagent. Here and there among the mass of spherules are scattered nuclei, evident on account of their staining very deeply with the reagent that produces no effect upon the surrounding granules; there were

no cell-outlines visible, but nevertheless I cannot but regard the mass as being composed of cells with perhaps very thin boundary lines. In the centre of each of these glands was a darkly staining rod of tissue which appears to be a blood-vessel; at the apex these glands opened into the lumen of the œsophagus by an exceedingly narrow diverticulum of the œsophagus; this tube soon ends, leaving the greater bulk of the calciferous gland composed of the peculiar tissue that I have already described.

The only other Oligochæts in which calciferous glands at all comparable to these exist are the genera *Gordiodrilus* and *Trichochaeta*. I have lately¹ described the principal anatomical characters of the former new genus, which is mainly found in tropical Africa, though also extending its range to the New World. In all the species of that genus there is a single unpaired median pouch in the ninth segment which in certain particulars resembles the calciferous glands of *Eudriloides durbanensis*; the resemblance consists in the tissue which builds up the greater part of the gland and which is apparently identical with that which builds up a greater proportion of the glands in *Eudriloides*. The peculiar kind of tissue which characterizes the calciferous glands of these two genera of Oligochæta is, however, not unknown in the group; in several aquatic Oligochæta, for example in some Naids and in many Lumbriculidæ such as *Sutroa*², the nephridium, just after traversing the septum, is swollen out into an oval tract which shows precisely the same structure as that of the glands already described. I have figured this tissue in the American Lumbriculid *Sutroa*, and suggested that it might possibly serve as a filtering tissue. The oval swelling is permeated by fine canaliculi which are not always apparent; in the same way the similar tissue in the calciferous glands of *Eudriloides* and of *Gordiodrilus* seems to be traversed by fine canaliculi (shown in the case of *Gordiodrilus* in fig. 8 of plate vii. of my memoir already quoted dealing with the anatomy of that worm). It is quite possible, therefore, that Michaelsen's notion that these glands serve as organs of assimilation, rather than as organs of secretion, may prove to be correct in the two Annelids which possess this peculiar form of calciferous gland; although, as I have pointed out, there can be no doubt that the ventral pouches of *Eudrilus* do not, at any rate, entirely serve such a purpose, for I found particles of calcareous secreted matter in the lumina of the said pouches; furthermore the resemblance of this tissue to that found in the nephridia is worthy of note in relation to the fact that in *Gordiodrilus* there appears to be a communication between the ventral pouches and the nephridia. I do not, however, wish to insist upon more than the actual structural likeness between the tissue in the two series of organs; this is indeed very striking. It may be that this resemblance between the calciferous pouches of *Eudriloides* and *Gordiodrilus* is some evidence

¹ "On a new Genus of Oligochæta &c.," Ann. & Mag. Nat. Hist. ser. 6, x. p. 74 (1892).

² "A Contribution to the Anatomy of *Sutroa*," Tr. Roy. Soc. Edinb. (to appear immediately).

of their affinity; *Gordiodrilus* is clearly a rather degenerate form, with no marked affinities to any other genera except to *Ocnero-drilus* and *Pygmæodrilus*—an affinity which may be merely due to the fact that they are all degenerate forms, and thus not a real affinity. In any case it is remarkable that this curious form of glandular tissue should be limited to the calciferous glands of the two genera *Eudriloides* and *Gordiodrilus*.

As regards the rest of the alimentary canal, there are not many points which require notice; there is a gizzard in the fifth segment, well developed and by no means rudimentary.

The first septum lies just in front of the gizzard and thus separates segments iv./v.; the four septa which follow the gizzard are thicker than the rest. The nephridia are of course paired, and the first pair appear to belong to the fourth segment.

There is only a single pair of testes, which lie in the ninth segment, attached to the front wall of that segment; opposite to them are the funnels of the sperm-ducts, these are very large and much folded. The sperm-duct has no swelling at its origin from the funnel; it is a narrow tube, much narrower than the oviduct; it opens into the atrium a little way before the opening of the latter into the terminal copulatory apparatus. The atria are two closely applied tubes contained within one sheath, so that on a dissection the atrium would no doubt appear to be single. Whether the division of the atrium is an indication of its being the result of the fusion of two separate atria is not obvious; at first sight it does appear to be obvious, but it will be remembered that in *Eudrilus* each atrium is similarly divided into two completely separated tubes within a common sheath. This atrium consists entirely of a layer of glandular cells ensheathed in a very thin peritoneal layer; the terminal apparatus is a muscular diverticulum of the body-wall, with which are also connected a pair of sacs each containing a single penial seta, whose shape I am unable to describe.

The spermatheca is unpaired, it opens on to the exterior in segment xiii.; the aperture leads into a thick-walled sac from which arises a thinner-walled sac extending backwards into the next segment; this latter is lined by cells which appear to be similar to those found in the corresponding organ of other *Eudrilidæ*, and suggest that in this species as in others the spermathecae are developed from the coelom, and are therefore not homologous with the spermathecae of other Earthworms. The terminal sac of the spermatheca is lined by an epithelium which has preserved the characters of the epidermis whence it is derived; the cells are of two kinds, the usual glandular and the interstitial cells.

To the spermatheca on each side is attached a receptaculum ovarum; these sacs, although attached to the spermatheca, are not really connected with it, that is to say they do not open on to the spermatheca; the egg-sacs are not in any way unusual in their structure, their cavity is divided up into numerous compartments by trabeculae. In the compartments are lodged the ova: the ova in the egg-sacs are not accompanied by masses of developing ova or by

cells serving as nutritive cells to the developing ova; the *oviducts* are peculiar in that they perforate the septum dividing segments xiii./xiv. twice. The funnel opens freely into the interior of segment xiii. right opposite the ovary and also into the interior of the egg-sac; it then passes into the cavity of the thirteenth segment and bending back runs straight along the body-wall up to its point of opening on to the exterior. The oviduct has thus an unusually long course, which is further increased by the fact that the pore is situated near to the hinder end of the fourteenth segment; the calibre of the oviduct is considerably greater than that of the spermiduct; the two can be easily compared in this respect, as the spermiduct passes close to the oviduct; the oviduct is not ensheathed in a muscular coat; the ciliated epithelium is only covered by a delicate peritoneal layer.

The ovaries lie in the thirteenth segment, attached, as is usual, to the front wall of that segment. The septum dividing segments xii./xiii. joins that which follows, and a sac is thus formed which encloses the ovaries and the terminal bulb of the spermatheca. Centrally this sac is almost filled by the bulb, but laterally there is plenty of room, and the spacious cavity thus formed is occupied not only by the ovaries and detached ova, but also by an immense quantity of small nucleated, often fusiform corpuscles; similar corpuscles are also found in great abundance in the xith segment. I am doubtful whether to regard these as slightly metamorphosed cells of the ovary and testis respectively or merely as perivisceral corpuscles, which happen to have been aggregated together in greater numbers in the two segments referred to than elsewhere.

The ripe ova (from the egg-sac) have no striated membrane such as is found in certain other Eudrilids.

This worm evidently belongs to one of the more simply organized of the Eudrilidæ; for the fusion of the female organs is incomplete. It must therefore be referred to one of the following genera, viz. *Eudriloides*, *Platydrilus*, *Megachæta*, *Reithrodrilus*, or *Notykus*.

As to external characters it agrees with *Platydrilus* in having a saddle-shaped clitellum, and also in the extent of the clitellum.

The internal anatomy is in some respects unlike any of these genera; for instance, the peculiar form of the calciferous glands marks out the present species from all Eudrilidæ including those mentioned, in none of which are there calciferous glands at all.

In possessing one pair of testes and in the corresponding single funnels &c. the worm resembles *Notykus*, *Eudriloides*, *Megachæta*?; but this is not of course an important difference from *Platydrilus* &c. The complete fusion of the two atria is peculiar to the worm, though a commencing fusion occurs in *Eudriloides*, from which, however, the species described here differs in the shortness of the atria and in the absence of a muscular tunic. The principal reason which leads me to refer the worm to the genus *Eudriloides* is the structure of the female organs. I have described the modification of the septum dividing segments xiii./xiv., which forms a sac enclosing the terminal part of the spermathecal sac and the ovaries and oviducal funnels:

though this seems to be perfectly similar to the arrangement figured by Michaelsen¹ for *Notykus emini*, I am inclined to think that in the latter there is a distinct sac independent of the septa.

VI. Family GEOSCOLECIDÆ.

15. *Trichochæta barbadensis*, n. sp.

I have examined a single specimen of this species which I received alive from Kew; it is a native of Barbadoes.

The worm was 24 mm. long and consisted of 84 segments; the colour during life was red, the skin containing no pigment.

The setæ are paired, their shape is precisely that of *Trichochæta hesperidum*, a new genus and species of Earthworms which I have recently² described from the island of Jamaica. On the clitellum the setæ appeared to be rather larger than those upon the other segments of the body, and the ornamentation at the tip a little more pronounced. Although the setæ in the present species show no trace of the characteristic irregularity of *Trichochæta hesperidum*, I do not hesitate to place them in the same genus on account of the peculiar form of the setæ, which is unmatched in any other Oligochæt. At first one would be inclined to regard the irregularity of the setæ as a mark of generic distinction; but it must be borne in mind that in *Pontoscolex*, as was first pointed out by Fritz Müller³, and I have been able to confirm his discovery, the setæ are occasionally regular and paired.

The clitellum, exceptionally for the family Geoscolecidæ, is complete; that is to say, there is no ventral tract free from glandular tissue. Rosa has used the saddle-shaped clitellum as one of the characters of the Geoscolecidæ; the present species shows that this character can be no longer used. The clitellum extends from the xiiiith segment to the xxiind.

The prostomium appeared, before the worm was examined by means of sections, to resemble that of *Rhinodrilus* or *Trichochæta hesperidum*, that is to say it lay apparently in the mouth instead of projecting above it. In longitudinal section, however, this appearance is seen to be largely due to the retraction of the prostomium, which is perhaps facilitated by the division of the first segment into two annuli by a groove.

The nephridia are paired, the first pair being rather larger than those which follow: the large size of the first pair of nephridia is commonly found to be a character of the Geoscolecidæ; it is hardly so pronounced in the present species as in *Pontoscolex* for example. The duct of this nephridium is long and appears to open on to the exterior on the third segment.

As to the vascular system, the only point that I particularly note is the presence of a pair of large hearts in each of segments x., xi.

¹ "Beschreibung der von Herrn Dr. Fr. Stuhlmann auf Sansibar &c.," JB. Hamb. wiss. Anst. ix.

² Q. J. M. S. Jan. 1893, p. 252.

³ "Description of a new Species of Earthworm," Ann. & Mag. Nat. Hist. ser. 2, vol. xx. p. 13 (translated from a paper in the Arch. f. Naturg.).

Separate calciferous glands like those of *Pontoscolex* do not exist in the present species, though it is very possible that three pairs of œsophageal cæca, the structure of which will be described presently, are the homologues of those glands. The calciferous glands are, however, functionally represented, as is so generally the case with Earthworms in which no separate cæca exist, by a tract of œsophagus with much folded walls; numerous crystals lying in the interstices of the folds appear to be the product of their epithelium, and are apparently similar to the crystals met with in true calciferous glands. This tract of œsophagus extends through about three segments, commencing with the tenth. It closely resembles the corresponding structure in the nearly allied form *Onychochaeta*¹.

In segments vii., viii., ix. are three pairs of very small œsophageal cæca; their calibre in transverse section is about the same as that of the dorsal vessel, but as they are very short and narrower at both extremities, they only possess even this small diameter for a limited distance. Each cæcum is lined by a layer of low cubical epithelium which does not appear to be ciliated; between this epithelium and the peritoneum is a plexus of blood-vessels which are very large in proportion to the cæcum itself, and protrude into the lumen, reducing it very greatly and causing it to assume here and there a star-shaped contour. It will be noticed that these cæca occupy the same segments as do the calciferous glands of *Pontoscolex*, and they may probably be safely regarded as the degenerate representatives of the latter.

The gizzard is large and extends apparently through a considerable number of segments; defining its limits by the septum which bounds it posteriorly, it would seem to lie in the sixth segment, but the anterior septa are not sufficiently clear to permit of fixing its anterior limits.

There are, as in some other Geoscolecidæ, only a single pair of testes. These belong to the xith segment, and are attached to the front wall of that segment. They are, together with the funnel of the vas deferens, enclosed in a sac, which extends back for some segments (to about the xviiith) and is the sperm-sac; the sperm-sacs, however, although the worm was fully mature, contained no sperm, and were of a very narrow calibre as in *Trichochaeta hesperidum*.

The funnel of the sperm-duct is very large and folded; the funnel extends below the testes and nearly reaches the septum to which the testis is attached; the posterior limit of the funnel, still of course enclosed within the sperm-sacs, is in the septum bounding segments xiii./xiv.; but they lie close to the ovary. The sperm-duct itself opens on to the exterior on or beyond the xviiith segment; I only traced it as far as the latter, but did not observe the actual opening. The ovaries are in xiii. and opposite to them are the funnels of the oviducts; the oviducal pores are just in the groove between the xivth and xvth segments. The spermatothecæ are three pairs of simple sacs like those of *Pontoscolex* in ix., x., xi.; the last pair open on to the boundary line of segments xi./xii.

¹ Q. J. M. S. vol. xxi. p. 159.

16. *Ilyogenia africana*, nov. gen., n. sp.

Among the specimens of *Eudriloides durbanensis* was an example of a totally different species—a fact which I only recognized after examining longitudinal sections of the head end of the worm; the smallness of size, absence of pigment, and similarity in the position of the clitellum prevented me from distinguishing them when alive. They belong, however, to totally different families; the species now to be described is a Geoscolecid.

It has paired setæ which show no recognizable ornamentation. I did not observe whether those upon the clitellum were in any way different from the rest.

The clitellum commences in the xiith segment and ends in the sixth; it is a little difficult to be precise about the actual beginning and ending. If we reckon as clitellum only that tract of epidermis where the “untere” and “obere Säulenregion” of Claparède can be recognized, then the clitellum begins at the commencement of segment xiii.; but the epidermis covering segment xii. dorsally differs from that lying in front by the fact that the glands are elongated and very darkly stained; they are indeed the exact counterpart of the clitellar gland-cells in many aquatic Oligochæta which I have examined when prepared in a similar fashion. These deeply staining cells contrast in that very particular with the clear and very faintly stained gland-cells of the segment in front. The clitellum is “saddle-shaped.” The nephridia are paired structures; the first pair are situated in segment iii. The funnels have the usual position and are not large. The nephridia themselves are without the terminal muscular duct; I observed the plexus formed by the “fine tubes” of the nephridium to which Benham has called attention in *Microchæta*. The external orifice of the nephridium is in front of the ventral setæ; those belonging to segment ix. open just behind but quite independently of the spermathecae. From the eighth segment, but more distinctly from the ninth, the nephridia are invested by a thick sheath of clear pyriform cells with deeply staining nuclei; the cells themselves are not much stained. These cells, which cover the nephridia, are sometimes quite clear but more often have a vacuolate appearance.

The alimentary canal presents the usual divisions; there is, however, no trace at all of a gizzard—not even the slightly thickened tract of muscle which marks a portion of the œsophagus in *Pontodrillus*. The pharynx commences in the second segment, the brain lying rather behind the transverse furrow which separates it from the buccal cavity, and therefore near to the posterior boundary of segment ii. The pharynx appears to occupy the third segment and a part of the fourth; as usual, numerous retractor muscles are inserted into its dorsal wall. Masses of septal glands occupy the fourth to the seventh segment; those of the last segment are very much smaller; the masses of unicellular glands of successive segments are connected by fibrous strands which pass through the septa. The œsophagus passes straight back to the twelfth segment, where it opens into the intestine. It is nowhere ciliated, except just

where it passes into the intestine; the latter tube is ciliated throughout. In the ixth segment a pair of ventrally situated calciferous glands arise from the œsophagus. The lumen of these is much divided; they are very vascular.

The circulatory system consists only of two longitudinal trunks—the dorsal and ventral vessels; I could find neither supra-intestinal nor subnervian. Another pair of longitudinal vessels exist in the anterior region of the body; these arise one on each side from the free extremity of the calciferous glands, and pass forwards through the septal glands. The last pair of hearts are in segment xi.; in front of these are two pairs which are equally large.

The two pair of testes are in x. and xi.; corresponding to them are two pairs of ciliated rosettes; the single sperm-duct of each side opens on to the xviiiith segment, and there are no glands of any kind or penial setæ associated with these orifices. One pair of spermathecae open on to the anterior boundary of segment ix.; they are simple oval pouches without diverticula and were full of sperm.

The sperm-sacs have an arrangement which is unusual among Earthworms in general and hitherto unknown in this particular family; they lie in segments ix. and xii., the intermediate segments being occupied by masses of developing sperm unenclosed by any membrane. The sperm-sacs of segments ix. and xii. are attached to the posterior and anterior septa respectively of their segments respectively and are racemose in form.

The ovaries lie in segment xiii. attached, as usual, to the front septum of the segment; they lie just above the nerve-cord, but below the ventral blood-vessel, and in the middle line are squeezed almost flat between the blood-vessel and the nerve-cord. In a continuous series of longitudinal sections the ovary of one side is seen to pass into that of the opposite side without any break, though the middle part is rather thinner. This is one of the very few Oligochæta with an unpaired ovary; *Æolosoma* is another instance, but in that Annelid the ovary is not plainly made up of two fused halves as it is in the species here described. Quite recently Schneider¹ has described a *Rhinodrilus* with a single ovary in segment xvii.: in view of the constancy in the position of the ovary, this statement in my opinion requires verification. The ripe ova are invariably surrounded by a follicle of relatively considerable thickness; this follicle has a fibrillated appearance, and there are numerous interspersed nuclei. There were ova, free from the follicle, within the mouth of the oviduct. The oviducts open on to the exterior part in front of the ventral setæ. There are no egg-sacs.

It is clear that this worm should be referred to the family Geoscolecidæ, but it is not clear as to which genus of that family it most nearly approaches: in the first place, it should be noted that *Ilyogenia* is in certain respects a somewhat degenerate form when compared with other Geoscolecidæ; this would in any case render the decision as to its affinities a matter of difficulty. The

¹ "Ueber eine neue Regenwurm Art auf Trinidad," Dorpat Naturf. Ges. Jhrg. 18, p. 42.

genus is so far degenerated that it possesses no gizzard, not even the faintest vestige of one; the nephridia, which in other Geoscolecidae have a large terminal end sac, very often with a capacious cæcum attached, are totally without anything of the kind. Another indication of a low position among the terricolous Oligochaeta is perhaps the opening of the sperm-ducts upon the xviiith segment; we find that this segment is the one which bears the pores in question in the genus *Oenerodrilus* and also in *Microdrilus* and *Microscolex*. It is a coincidence, though probably no more, that there is but one pair of calciferous glands and that these are in the ninth segment; in three low forms of terrestrial Oligochaeta we meet with exactly the same condition of the calciferous glands, viz., in *Oenerodrilus*¹, *Gordiodrilus*², and in the Acanthodrilid *Kerria*.³ As, however, there are Geoscolecids (such as *Microchaeta*) in which the calciferous glands are similarly reduced to one pair, but which are evidently not degenerate forms, too much stress cannot be prudently laid upon the point of similarity to the three genera aforementioned.

Rosa⁴ and I⁵ have independently pointed out that the family Geoscolecidae can be most conveniently divided into two subfamilies, confined respectively (with the exception only of *Pontoscolex*, which is cosmopolitan) to the Old and to the New World; I need not again go into the matter here, as the reasons which led me to this conclusion have been fully given in the paper quoted below. The present genus interferes with the symmetry of this proposed arrangement; it evidently belongs in structure to the New World section of the family, but lives in the Old World. The spermathecae lie in front of the testes and the other reproductive organs, and there are no copulatory papillae.

The genus *Ilyogenia* agrees with no other genus in every point: the form and position of the sperm-sacs are unique in the family; the ventral position of the nephridiopores is characteristic of the genus *Geoscolex*, with which, however, *Ilyogenia* has no other marked points of resemblance. It comes nearest, perhaps, to *Anteus* and *Rhinodrilus*; but differs from both of these genera in a number of small differences, which are, in my opinion, collectively at least, of sufficient importance to justify its distinction by a separate generic name.

VII. EXPLANATION OF PLATES XLV. & XLVI.

- Fig. 1. Part of an egg-sac of *Moniligaster bahamensis*, showing ripe ova.
 2. Spermatheca of *Moniligaster bahamensis*: a, transverse section.
 3. Ventral view of anterior segments of same; the segments are numbered.
 4. Male genital apparatus of the same worm; the figure is reconstructed from a series of sections.

¹ "On the Anatomy of *Oenerodrilus*," Tr. Roy. Soc. Edinb. vol. xxxvi. no. 21.

² "On a new Genus of Oligochaeta, &c.," Ann. & Mag. Nat. Hist., July 1892.

³ P. Z. S. 1892, p. 355.

⁴ *Kymotus michaelsonii*, n. sp. "Contributo alla morfologia dei Geoscolecidi," Boll. Mus. Zool. vol. vii. no. 119.

⁵ Q. J. M. S. vol. xxxiv. p. 258.

- Fig. 5. Transverse section through the clitellum of the same, to show the unicellular layer of the epidermis and the hollow fibres of the transverse muscular coat.
6. Ventral view of the genital segments of *Benhamia crassa*; the clitellum is shaded and the groove connecting the atrial pores is shown.
 7. Spermatheca of the same.
 8. Calciferous glands of *Microdrilus asiaticus*.
 - 9, 10. Genital setae of *Acanthodrilus smithi*, in lateral and ventral view.
 11. A rudimentary calciferous gland of *Eudriloides durbanensis*.
 12. A spermatheca of *Acanthodrilus smithii*.
 13. A penial seta of *Microdrilus asiaticus*.
 14. Genital organs of *Eudriloides durbanensis*; the segments are numbered.

2. On the Presence of a Branchial Basket in *Myxine glutinosa*. By R. H. BURNE, B.A., F.Z.S., Anatomical Assistant at the Royal College of Surgeons of England.

[Received December 6, 1892.]

(Plate XLVII.)

One would expect the branchial basket, which forms such a large and striking part of the skeleton of the Lampreys, to be present, at least to some extent, in their nearest allies, the Hags; and, in fact, such is the case, for in 1835 Johannes Müller, in his work upon the Myxinoids¹, described and figured a small triradiate piece of cartilage supporting the anterior and dorsal faces of the cutaneo-oesophageal duct of *Bdellostoma*, which cartilageno doubt is the homologue of a branchial basket. Again, in 1883 Parker² mentioned this cartilaginous support to the cutaneo-oesophageal duct of *Bdellostoma*, representing it as an irregular plate having the same position as Müller's triradiate cartilage.

Manifestly, as far as *Bdellostoma* is concerned, there is a branchial skeleton which, although present on one side only, cannot well be anything but a branchial basket in a very much reduced condition. This being the case, one would naturally expect to find some such supporting structure to the gill-tubes of *Myxine glutinosa*, but neither Müller, Parker, nor, as far as I can discover, any other observer has found anything answering to it; I fancy, however, that Müller implies in a passage which I quote below³ that he believed that some such branchial skeleton was present, although he was unable to actually demonstrate it.

While lately preparing a series of Marsipobranch skeletons for the Museum of the Royal College of Surgeons, I naturally was on the look-out for this cartilage both in *Bdellostoma* and *Myxine*.

¹ J. Müller, 'Vergleichende Anatomie der Myxinoiden' (Berlin, 1835), p. 122.

² W. K. Parker, "On the Skeleton of the Marsipobranch Fishes.—Pt. I. Myxinoids," Phil. Trans. 1883.

³ L. c. p. 122. "Dieser Knorpel (in *Bdellostoma*) ist sehr zart und dünn, und kann bei *Myxine*, wegen der Feinheit der Theile, nicht mehr nachgewiesen werden."